ENDOSULFAN

The Kerala Story

Government of Kerala
India

REPORT ON HEALTH EFFECTS OF ENDOSULFAN

AND PROGRESS OF REHABILITATION ACTIVITIES

IN KERALA

Department of Health and family welfare, Government of Kerala

20th April 2011

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Foreword

This is an attempt to convey our grave concern over the issue of health effects caused by endosulfan in our state with a pray to support the global ban on this dreaded pesticide. Our experts on systematic review of literature realised that Kasaragodu district in the state is just one of the places in the country and the world which has witnessed the ill effects of this poison. I am indeed surprised to know that there are hundreds of studies which have cleared beyond misgiving the deleterious health effects of this endosulfan.

We as a state have withheld the use of this pesticide since over a decade and now involved in rehabilitation of the victims of endosulfan in Kasaragodu. Kerala have been voicing this to the centre at several occasions since 2002. Now I have no hesitation in revealing that the centre has always tried to down play the issue and resisted the global movement to ban the use of this Persistent Organic Pollutant.

This report is a mark of our struggle against the use of endosulfan, a reflection of what has happened in part of our state and what we are doing to rehabilitate them and a hope for safer healthier nation and world.

V.S. Achuthanandan.

Thiruvananthapuram, Dated 22nd April, 2011.

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DATE :..21/04/11.....

Endosulfan, a Persistent Organic Pollutant, has emerged as a grave public health and social issue which warrants immediate global action. The experts in health and several committees including the NIOH under the Indian Council of Medical Research has reiterated the harmful effects of Endosulfan on various systems of the human body.

This report mentions few of the studies done by independent researchers and several prestigious institutions from various parts of the world and published in peer reviewed scientific journals. But it is unfortunate that there are few people in power at the centre, who still needs more 'local' proofs on health effects of this dreaded chemical. I must say that this attitude accounts to abusing science. What happened in Kasaragodu is not something unique but a reflection of many of such occurrence in the country as evident from reports from our neighbouring state.

This report is our humble effort to portray our experience in identifying and rehabilitating the probable victims of Endosulfan and the scientific basis for the same.

Introduction

History and Background

Endosulfan, a highly toxic organochlorine pesticide was sprayed in the cashew plantations in Kasaragod District since 1978, till 2001 regularly three times every year. The aerial spraying of Endosulfan was undertaken to contain the menace of the tea mosquito bug.

As early as 1979, stunted growth and deformed limbs were noticed among new born calves. By 1990s health disorders of very serious nature among the human population came to the lime light. Children were found to be the worst affected with congenital anomalies, mental retardation, physical deformities, cerebral palsy, epilepsy, hydrocephalus etc. Men and women were also affected with various chronic ailments, many irreversible and difficult to treat. From the mid of 1990's, the community living near plantations had been complaining against the spraying of Endosulfan.

Enquiry Commissions

Govt of Kerala and Govt. of India had appointed 11 various commissions to inquire about the issue. Various Non-Government Organizations also made some studies at their own level. Most of the studies revealed the hazards of Endosulfan use and its impact on the food, water and beverages. These enquiry reports in one way or other infer that pesticide Endosulfan is responsible for the horrendous mutations and ailments that many in the villages of Kasaragod district are suffering form. From 2000 onwards committees of various departments, Non-Governmental Organizations, Indian Council of Medical Research and other agencies conducted visits to the area and submitted reports to the Government regarding this issue.

Prominent among them are:

1. Committee appointed by Kerala Agricultural University with Dr. Abdul Salam as Chairman.

2. Committee appointed by Government of Kerala with Dr. Achuthan as Chairman.

3. Committee from National Institute of Occupational Health, ICMR, Ahemedabad.

Following reports in public domain have been published which are available on website www.endosulphanvictims.org

The major conclusions of NIOH (under ICMR) in 2002 were:

- There is significantly higher prevalence of neurobehavioural disorders, congenital malformations in female subjects and abnormalities related to male reproductive system in the study group (Padre village, Enmakaje Panchayat) as compared to the reference group (Miyapavadu village of Meenja Panchayat).
- Regarding the aetiological factors, responsible for these health problems, various factors were compared and it was found that the two groups differed mainly with respect to exposure to endosulfan.

Court Orders:

A victim, Smt. Leela Kumari Amma approached a lower court (Munsif Court, Hosdurg) in 2001 and the court temporarily stayed aerial spraying of Endosulfan in Cashew plantations. In 2003, the High Court of Kerala upheld the order of lower court and it permanently stopped Endosulfan spraying.

Since then, the Govt.of Kerala imposed a ban on the use of Endosulfan.

Adding to these the Government of Kerala ordered for three scientific studies in 2010:

1. Calicut Medical College: for epidemiological study: Submitted preliminary report.
2. Rajiv Ghandi Centre for Biotechnology: for genetic study. : Proposal submitted.
3. Kerala state council for science and technology for environmental study

Major conclusion of the epidemiological study by Calicut Medical College (Dec 2010- Jan 2011):

- The reproductive health events including infertility, precocious puberty, abortion, intra uterine death (IUD)/ still birth, neonatal/ child death were found significantly higher in study population when compared to control population.
- Among the youth population (below the age of 40-) the rate of surgery for any heart diseases , hernia and genito urinary causes were higher in area study group than control group.
- When the prevalence of morbidity in adolescents were assessed it was found that any organ anomaly , birth defects, congenital heart disease, seizure, skin problems and reproductive disorders were significantly higher in study group when compared to control groups.

2. Rehabilitation: 'snehasanthwanam' progress till date

HEALTH SECTOR

1. Identification of patients and scientific evaluations:

Though the efforts for identification of endosulfan victims were on from 2003, an active search for affected patients started in later half of 2010.

Progress till date:

1.1 **Two house to house surveys and series of specialty medical camps** were conducted in November, December 2010 and January 2011:

A. **Socioeconomic survey:** primarily aimed at ascertaining the economic status , loss of livelihood due to ailments , loan indebtness , patient status , loss of education , problems in getting married due to social stigma and other such issues.

B. **Health survey:** for identifying self-reported ailments in the affected panchayats. This was done by health workers and ASHA volunteers.

C. **Specialty Medical camps:**

Though the health survey gave a bird's eye view of disease load of the affected areas, it failed to identify specific ailments. So it was decided that the

best available experts should be pooled in to conduct specialty medical camps with following objectives:

- To identify endosulfan medical victims, diagnose their specific ailments, prescribe long-term treatment for them by a team of expert medical colleges.
- To quantify and keep an account of all required treatments and the institutions from which these treatments can be availed.
- To enroll patients for providing treatment smart card and prioritize the need for specialized care.

Conduct of camps:

One specialty Medical camps were conducted in each panchayat from 16.12.2010 to 09.01.2011 in all the affected 11 Panchayaths, followed by 1 'mop up' camps for two panchayat, taking the toll of specialty camps to 17.

About 125specialist from Govt. Medical Colleges and 175 doctors from health services were roped in to the camps.

Camp pattern was as follows:

- **Registration:** There were 8-10 registration counters with 3 staff at each counter. Details of all patients were meticulously registered. The patients were provided with 2 forms (enclosed as annexure):
    a. Form 1: for details of the clinical condition and treatment suggested, which was entered and analyzed using SPSS after the camps.
    b. Form 2: drug prescription forms which were given to the patient.
- **Screening**: 10 to 15 general practitioners from health service screened the registered patients and referred them to respective specialty clinics (may be more than one). ASHA workers and volunteers directed and often accompanied the patients to the specialty clinics.
- **Specialty clinics**: Separate rooms were provided for each specialty clinic. Apart from specialists each consultation rooms were provided with:

c. Two nursing students or one staff nurse + one nursing student

d. One field staff

e. Nursing assistant (in O&G) and refractionist (in Ophthalmology)

f. General equipments and facilities including BP apparatus, Steth, Torch, antiseptic hand rub/wash, tissue paper

g. Specialized equipments like: ophthalmoscope, slit lamp, tuning fork, knee hammer etc

The specialties included:

Sl no	Specialty	No. of specialist at each camp site
1	General Medicine	2 to 4
2	Neurology	3 to 4
3	Gynecology	2
4	ENT	2
5	Psychiatry	2
6	Dermatology	2
7	Orthopedics	2

8	Ophthalmology	2
9	Oncology	1-2
10	Surgery	2
11	Pediatrics	2
12	Chest diseases	1-2

- **Lab**: Facilities were provided for routine investigations. Patients requiring advanced investigations will be availed the same after consolidation.
- **Pharmacy:** For the drugs not available at Pharmacy, a register was maintained and efforts are on to supply it to the patient as soon as possible.
- **Lunch and refreshment:** Lunch and light refreshment will be provided here for doctors (in rotation), staff and volunteers at 11 am and lunch at 2pm. Patients who had to wait afternoon were provided lunch in the third and fourth camps. This may be replicated elsewhere.

Transport of patients: 10 Vehicles (including 2 ambulances) were provided for to and fro transportation of patients. Health worker or ASHAs accompanied the patients whenever warranted. **Special care was taken to ensure public participation and the involvement and cooperation of LSG institutions were inspiring.**

Dates	Panchayats
16-12-10	Kayyur Chemeni
17-12-10	Muliyar
18-12-10	Enmagaje
19-12-10	Panathur
06-01-11	Periya
07-01-11	Bellor
08-01-11	Kumbadaje
09-01-11	Badiyaduka
10-01-11	Kallar, Enmagaje, Kumbadaje (3camps)
11-01-11	Mulleria, Pullur, Kayyur (3camps)
12-01-11	Ajanur, Muliyar, Kallar (3camps)

Total number of patients attended in the camps: 15698

The scientific basis for including a disease as due to endosulfan

Probable Endosulfan victim: Inclusion criteria:

The history, diagnosis and treatment required were entered in SPSS and analyzed using PASW. The factors which were considered for labeling a case as suspected endosulfan victims are as follows:

1. History of Exposure: This can be :
    a) Occupational
    b) Non- occupational
    c) Mother to child through placenta and breast milk

        (Details in monograph on endosulfan enclosed as annexure)

2. Evidence based:

    Based on evidence from over 140 published studies about health effects of endosulfan, from various parts of the world.

    (References attached as annexure 1)

    However the benefit of doubt favored the patients.

From the systematic literature review of scientific journals published in peer reviewed journals, it became evident that, not only the association between endosulfan and its health effects, but also even the mechanism by which it harms the body is also established:

1. **Endosulfan affects nervous system of even during gestational period.**

Effects on **Nervous system: published studies**

1. Alexsandrowicz DR. 1979. Endosulfan poisoning and chronic brain syndrome. *Arch Toxicol* 43:65-8.
2. Benamú MA, Schneider MI, Pineda S, Sanchez NE, Gonzalez A. 2007. Sublethal effects of two neurotoxican insecticides on Araneus pratensis (Araneae: Araneidae). *Commun Agric Appl Biol Sci* 72(3):557-9.
3. Cabaleiro T, Caride A, Romero A, Lafuente A. 2008. Ef *Neurotoxicol Teratol* 24(6):797-804.fects of *in utero* and lactational exposure to endosulfan in prefrontal cortex of male rats. *Toxicol Letts* 176:58–67.
4. Castillo, CG, Montante M, Dufour L, Martínez ML, Jiménez-Capdeville ME. 2002. Behavioral effects of exposure to endosulfan and methyl parathion in adult rats.
5. Dutta H, Arends DA. 2003. Effects of endosulfan on brain acetylcholinesterase activity in juvenile bluegill sunfish. *Environ Res* 91:157–62.
6. Damgaard IN, Skakkebaek NE, Toppari J, Virtanen HE, Shen H, Schramm KW, Petersen JH, Jensen TK, Main KM, Nordic Cryptorchidism Study Group. 2006. Persistent pesticides in human breast milk and cryptorchidism. *Environ Health Perspect.* 114(7):1133-8
7. Gormley KL, Teather KL. 2003. Developmental, behavioral, and reproductive effects experienced by Japanese medaka (*Oryzias latipes*) in response to short-term exposure to endosulfan. *Ecotox Environ Saf* 54:330-38.
8. Jia Z, Misra HP. 2007a. Developmental exposure to pesticides zineb and/or endosulfan renders the nigrostriatal dopamine system more susceptible to these environmental chemicals later in life. *Neurotoxicology* 28(4):727-35.
9. Pradhan S, Pandey N, Phadke RV, Kaur A, Sharma K, Gupta RK. 1997. Selective involvement of basal ganglia and occipital cortex in a patient with acute endosulfan poisoning. *J Neurol Sci* 147(2):209-13.
10. Roberts DM, Dissanayake W, Sheriff MHR, Eddeston M. 2004. Refractory status epilepticus follow self-poisoning with the organochlorine pesticide endosulfan. *J Clin Neurosci* 11(7):760-62.
11. Roberts EM, English PB, Grether KJ, Windham GC, Somberg L, Wolff C. 2007. Maternal residence near agricultural pesticide applications and autism spectrum disorders among children in the California Central Valley. *Environ Health Perspect* 115(10):1482-9.
12. Wang XF, Li S, Chou AP, Bronstein JM. 2006a. Inhibitory effects of pesticides on proteasome activity: implication in Parkinson's disease. *Neurobiol Dis* 23(1):198-205.
13. Vale C, Fonfria E, Bujons J, Messeguer A, Rodriguez-Farre E, Sunol C. 2003. The organochlorine pesticides gamma-hexachlorocyclohexane (lindane), alpha-endosulfan and dieldrin differentially interact with GABA(A) and glycine-gated chloride channels in primary cultures of cerebellar granule cells. *Neuroscience* 117(2):397-403.

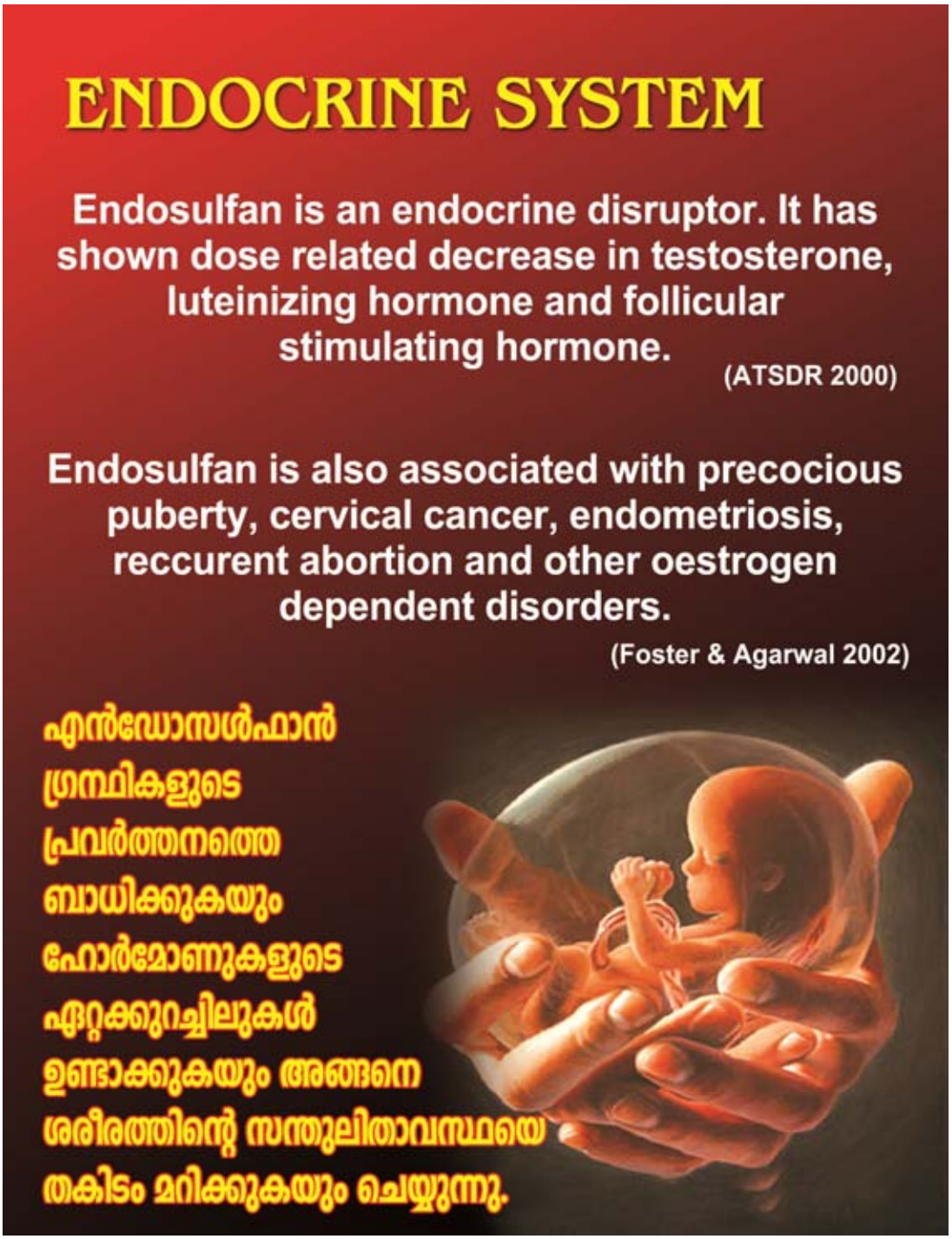
2. Endosulfan affects reproduction:

Effects on **reproductive system: published studies**

1. Andersen HR, Vinggaard AM, Rasmussen TH, Gjermandsen IM, Bonefeld-Jorgensen EC. 2002. Effects of currently used pesticides in assays for estrogenicity, androgenicity, and aromatase activity in vitro. *Toxicol Appl Pharmacol* 179(1):1-12.
2. 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.
3. Pathak R, Suke SG, Ahmed T, Ahmed RS, Tripathi AK, Guleria K, Sharma CS, Makhijani SD, Banerjee BD. 2010. Organochlorine pesticide residue levels and oxidative stress in preterm delivery cases. *Hum Exp Toxicol 2010* 29(5):351-8.
4. Koç ND, Kayhan FE, Sesal C, Muşlu MN. 2009. Dose-dependent effects of endosulfan and malathion on adult Wistar albino rat ovaries. *Pak J Biol Sci* 12(6):498-503.
5. Campoy C, Jimenz M, Olea-Serrano MF, Moreno-Frias M, Canabate F, Olea N, Bayes R, Molina-Font JA. 2001. Analysis of organochlorine pesticides in human milk: preliminary results. *Early Hum Devel* 65(s2):S183-190.
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):233-39.
7. Cossette LJ, Gaumond I, Martinoli MG. 2002. Combined effect of xenoestrogens and growth factors in two estrogen-responsive cell lines. *Endocrine* 18(3):303-8.
8. Dalsenter PR, Dallegrave E, Mello JR, Langeloh A, Oliveira TR, FaqiAS. 1999. Reproductive effects of endosulfan on male offspring of rats exposed during pregnancy and lactation. *Hum Exp Toxicol* 18(9):583-89.
9. Damgaard IN, Skakkebaek NE, Toppari J, Virtanen HE, Shen H, Schramm KW, Petersen JH, Jensen TK, Main KM, Nordic Cryptorchidism Study Group. 2006. Persistent pesticides in human breast milk and cryptorchidism. *Environ Health Perspect.* 114(7):1133-8.
10. Dutta HM, Misquitta D, Khan S. 2006. The effects of endosulfan on the testes of bluegill fish, *Lepomis macrochirus*: a histopathological study. *Arch Environ Contam Toxicol* 51(1):149-56.
11. Foster WG, Agarwal SK. 2002. Environmental contaminants and dietary factors in endometriosis. *Ann NY Acad Sci* 955(1):213-29.
12. 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.
13. 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.
14. Grunfeld HT, Bonefeld-Jorgensen EC. 2004. Effect of in vitro estrogenic pesticides on human oestrogen receptor alpha and beta mRNA levels. *Toxicol Lett* 151(3):467-80.

15. Hiremath MB, Kaliwal BB. 2002. The anti-implantation action of endosulfan in albino mice: possible mechanisms. *J Basic Clin Physiol Pharmacol* 13(4):329-40.
16. Kojima H, Katsura E, Takeuchi S, Niiyama K, Kobayashi K. 2004. Screening for estrogen and androgen receptor activities in 200 pesticides by *in vitro* reporter gene assays using Chinese hamster ovary cells. *Environ Health Perspect* 112(5):524-31.
17. Lemaire G, Mnif W, Mauvais P, Balaguer P, Rahmani R. 2006. Activation of alpha- and beta-estrogen receptors by persistent pesticides in reporter cell lines. *Life Sci* 79(12):1160-9.
18. Li X, Zhang S, Safe S. 2006a. Activation of kinase pathways in MCF-7 cells by 17*B*-estradiol and structurally diverse estrogenic compounds. *J Steroid Biochem Mol Biol* 98(2-3):122-32.
19. Lutter C, Iyengar V, Barnes R, Chuvakova T, Kazbekova G, Sharmanov T. 1998. Breast milk contamination in Kazakhstan: implications for infant feeding. *Chemosphere* 37(9-12):1761-72.
20. Palma P, Palma VL, Fernandes RM, Soares AMVM, Barbosa IR. 2008. Endosulfan sulphate interferes with reproduction, embryonic development and sex differentiation in Daphnia magma. *Ecotoxicol Envion Saf* June 9 [Epub ahead of print].
21. Rousseau J, Cossette L, Grenier S, Martinoli MG. 2002. Modulation of prolactin expression by xenoestrogens. *Gen Comp Endocrinol* 126(2):175-82.
22. Rupa DS, Reddy PP, Reddi OS. 1991. Reproductive performance in population exposed to pesticides in cotton fields in India. *Environ Res* 55(2):123-8.
23. 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.
24. 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.
25. Shen H, Main KM, Virtanen HE, Damgaard IN, Haavisto A-M, Kaleva M, Boisen KA, Schmidt IM, Chellakooty M, Skakkebaek NE, Toppari J, Schramm K-W. 2007. From mother to child: investigation of prenatal and postnatal exposure to persistent bioaccumulating toxicants using breast milk and placenta biomonitoring. *Chemosphere* 67:S256-62.
26. Shen H, Main KM, Andersson A-M, Damgaard IN, Virtanen HE, Skakkebaek NE, Toppari J, Schramm K-W. 2008. Concentrations of persistent organochlorine compounds in human milk and placenta are higher in Denmark than in Finland. *Hum Reprod* 23(1):201-10.
27. Soto AM, Chung KL, Sonnenschein C. 1994. The pesticides endosulfan, toxaphene, and dieldrin have estrogenic effects on human estrogen-sensitive cells. *Environ Health Perspect* 102(4):380-83.
28. Toniolo PG, Levitz M, Zeleniuch-Jacquotte A, Banerjee S, Koenig KL, Shore RE, Strax P, Pasternack BS. 1995. A prospective study of endogenous estrogens and breast cancer in postmenopausal women. *J Natl Cancer Inst* 87:190-7.

3. Endosulfan is an endocrine disruptor:



Endocrine System published studies

1. Andersen HR, Vinggaard AM, Rasmussen TH, Gjermandsen IM, Bonefeld-Jorgensen EC. 2002. Effects of currently used pesticides in assays for estrogenicity, androgenicity, and aromatase activity in vitro. *Toxicol Appl Pharmacol* 179(1):1-12.

2. Berrino F, Muti P, Micheli A, Bolelli G, Krogh V, Sciajno R, Pisani P, Panico S, Secreto G. 1996. Serum sex hormone levels after menopause and subsequent breast cancer. *J Natl Cancer Inst* 88:291-6.

3. Bonefeld-Jorgensen EC, Grunfeld HT, Gjermandsen IM. 2005. Effect of pesticides on estrogen receptor transactivation in vitro: a comparison of stable transfected MVLN and transient transfected MCF-7 cells. *Mol Cell Endocrinol* 244(1-2):20-30.
4. Bradlow HL, Davis DL, Lin G, Sepkovic D, Tiwari R. 1995. Effects of pesticides on the ratio of 16/2-hydroxyestrone: a biologic marker of breast cancer risk. *Environ Health Perspect* 103 (S-7):147-50.

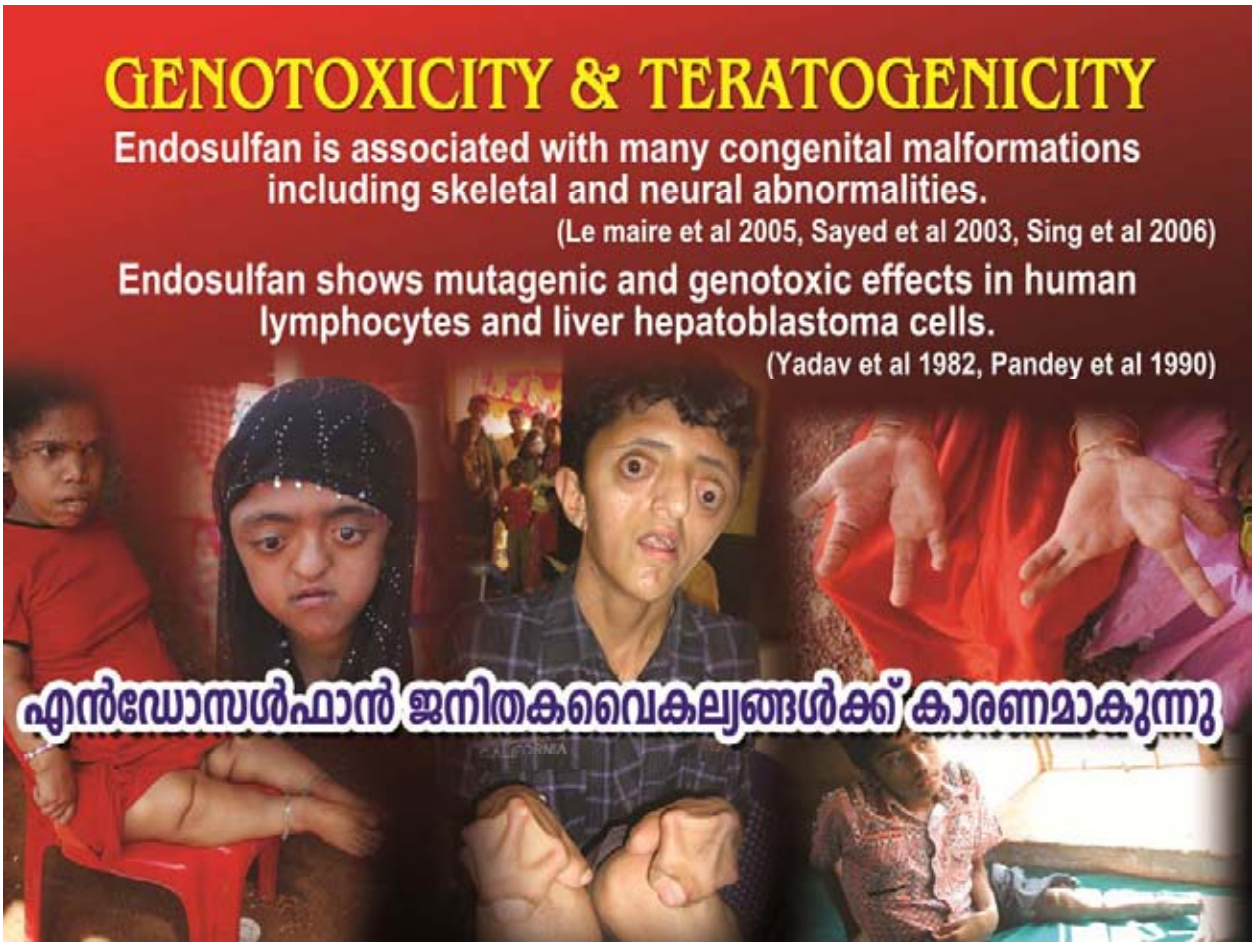
5. Bulayeva NN, Watson CS. 2004. Xenoestrogen-induced ERK-1 and ERK-2 activation via multiple membrane-initiated signalling pathways. *Environ Health Perspect* 112(15):1481-7.
6. Caride A, Lafuente A, Cabaleiro T. 2010. Endosulfan effects on pituitary hormone and both nitrosative and oxidative stress in pubertal male rats. *Toxciol Letts* 197(2):106-12.

7. Chatterjee S, Kumar V, Majumder CB, Roy P. 2008. Screening of some anti-progestin endocrine disruptors using a recombinant yeast-based in vitro bioassay. *Toxicol in Vitro* 22(3):788-98.
8. Coimbra AM, Reis-Henriques MA, Darras VM. 2005. Circulating thyroid hormone levels and iodothyronine deiodinase activities in Nile tilapia (*Oreochromis niloticus*) following dietary exposure to Endosulfan and Aroclor 1254. *Comp Biochem Physiol C Toxicol Pharmacol* 141(1):8-14.
9. Den Hond E, Schoeters G. 2006. Endocrine disrupters and human puberty. *Int J Androl* 29(1):264-71.
10. Dorgan JF, Longcope C, Stephenson HE, Falk RT, Miller R, Franz C, Kahle L, Campbell WS, Tangrea JA, Schatzkin A. 1996. Relation of prediagnostic serum estrogen and androgen levels to breast cancer risk. *Cancer Epidemiol Biomark Prev* 5:533-9.

11. Dorval J, Leblond VS, Hontela A. 2003. Oxidative stress and loss of cortisol secretion in adrenocortical cells of rainbow trout (*Oncorhynchus mykiss*) exposed in vitro to endosulfan, an organochlorine pesticide. *Aquat Toxicol* 63(3):299-41.
12. Grunfeld HT, Bonefeld-Jorgensen EC. 2004. Effect of in vitro estrogenic pesticides on human oestrogen receptor alpha and beta mRNA levels. *Toxicol Lett* 151(3):467-80.
13. Hunter DS, Hodges LC, Vonier PM, Fuchs-Young R, Gottardis MM, Walker CL. 1999. Estrogen receptor activation via Activation Function 2 predicts agonism of xenoestrogens in normal and neoplastic cells of the uterine myometrium. *Cancer Res* 59:3090-9.

14. Jin L, Tran DQ, Ide CF, McLachlan JA, Arnold SF. 1997. Several synthetic chemicals inhibit progesterone receptor-mediated transactivation in yeast. *Biochem Biophys Res Commun* 233(1):139-46.
15. Kojima H, Katsura E, Takeuchi S, Niiyama K, Kobayashi K. 2004. Screening for estrogen and androgen receptor activities in 200 pesticides by *in vitro* reporter gene assays using Chinese hamster ovary cells. *Environ Health Perspect* 112(5):524-31.
16. Laville N, Balguerf P, Brion F, Hinfray N, Casellas C, Porcher JM, Ait-Aissa S. 2006. Modulation of aromatase and mRNA by various selected pesticides in the human choriocarcinoma JEG-3 cell line. *Toxicology* 228(1):98-108.
17. Lemaire G, Mnif W, Mauvais P, Balaguer P, Rahmani R. 2006. Activation of alpha- and beta-estrogen receptors by persistent pesticides in reporter cell lines. *Life Sci* 79(12):1160-9.
18. Li X, Zhang S, Safe S. 2006a. Activation of kinase pathways in MCF-7 cells by 17*B*-estradiol and structurally diverse estrogenic compounds. *J Steroid Biochem Mol Biol* 98(2-3):122-32.
19. Palma P, Palma VL, Matos C, Fernandes RM, Bohn A, Soares AMVM, Barbosa IR. 2009. Assessment of the pesticides atrazine, endosulfan sulphate and chlorpyrifos for juvenoid-related endocrine activity using Daphnia magna. *Chemosphere 76* 335-40.
20. Rousseau J, Cossette L, Grenier S, Martinoli MG. 2002. Modulation of prolactin expression by xenoestrogens. *Gen Comp Endocrinol* 126(2):175-82.
21. Soto AM, Chung KL, Sonnenschein C. 1994. The pesticides endosulfan, toxaphene, and dieldrin have estrogenic effects on human estrogen-sensitive cells. *Environ Health Perspect* 102(4):380-83.
22. Soto AM, Sonnenschein C, Chung KL, Fernandez MF, Olea N, Serrano FO. 1995. The E-SCREEN assay as a tool to identify estrogens: an update on estrogenic environmental pollutants. *Environ Health Perspect* 103(Suppl 7):113-22.
23. Toniolo PG, Levitz M, Zeleniuch-Jacquotte A, Banerjee S, Koenig KL, Shore RE, Strax P, Pasternack BS. 1995. A prospective study of endogenous estrogens and breast cancer in postmenopausal women. *J Natl Cancer Inst* 87:190-7.
24. Watson C, Bulayeva NN, Wozniak AL, Alyea RA. 2007. Xenoestrogens are potent activators of nongenomic estrogenic responses. *Steroids* 72:124-34.
25. Wong PS, Matsumura F. 2006. Serum free BG-1 cell proliferation assay: a sensitive method for determining organochlorine pesticide estrogen receptor activation at the nanomolar range. *Toxicol In Vitro* 20(3):382-94.
26. Wozniak AL, Bulayeva NN, Watson CS. 2005. Xenoestrogens at picomolar to nanomolar concentrations trigger membrane estrogen receptor-alpha-mediated Ca^{2+} fluxes and prolactin release in GH3/B6 pituitary tumor cells. *Environ Health Perspect* 113(4):431-9.
27. Zhu Z, Edwards RJ, Boobis AR. 2009. *Increased expression of histone proteins during estrogen-mediated cell proliferation. Environ Health Perspect 117:928–934.*

4. Endosulfan is genotoxic, cytotoxic and mutagenic:



Genotoxicity/ Cytotoxicity/ Teratogenecity: Published studies:

1. Akcha F, Arzul G, Rousseau S, Bardouil M. 2008. Comet assay in phytoplankton as biomarker of genotoxic effects of environmental pollution. *Mar Environ Res* 66(1):59-61.

2. Antherieu S, Ledirac N, Luzy AP, Lenormand P, Caron JC, Rahmani R. 2007. Endosulfan decreases cell growth and apoptosis in human HaCaT keratinocytes: Partial ROS-dependent ERK1/2 mechanism. *J Cell Physiol* 213(1):177-86
3. Arrebola FJ, Martinez Vidal JL, Fernandez-Gutierrez A. 2001. Analysis of endosulfan and its metabolites in human serum using gas chromatography-tandem mass spectrometry. *J Chromatogr Sci*39(5):177-82.n
4. Ballesteros ML, Wunderlin DA, Biston MA. 2008. Oxidative stress responses in different organs of *Jenynsia multidentata* exposed to endosulfan. *Ecotox Environ Saf* Feb 26 [Epub ahead of print].
5. Bajpayee M, Pandey AK, Zaidi S, Musarrat J, Parmar D, Mathur N, Serth PK, Dhawan A. 2006. DNA damage and mutagenicity induced by endosulfan and its metabolites. *Environ Mol Mutagen* 47(9):682-92.
6. Benjamin N, Kushwah A, Sharma RK, Katiyar AK. 2006. Histo-pathological changes in liver, kidney and muscles of pesticides exposed malnourished and diabetic rats.
7. Bisson M, Hontela A. 2002. Cytotoxic and endocrine-disrupting potential of atrazine, diazinon, endosulfan, and mancozeb in adrenocortical steroidogenic cells of rainbow trout exposed in vitro. *Toxicol Appld Pharmacol* 180(2):110-7.*Indian J Exp Biol* 44(3):228-32.
8. Choudhary N, Sharma M, Verma P, Joshi SC. 2003. Hepato and nephrotoxicity in rat exposed to endosulfan. *J Environ Biol* 24(3):305-8.
9. Daniel CS, Agarwal S, Agarwal SS. 1986. Human red blood cell membrane damage by endosulfan. *Toxicol Letts* 32(1-2):113-8.
10. Dubois M, Pfohl-Leszkowicz A, De Waziers I, Kremers P. 1996. Selective induction of the CYP3A family by endosulfan and DNAadduct formation in different hepatic and hepatoma cells. *Environ Toxicol Pharmacol* 1(1):249-56.
11. Hashizume T, Yoshitomi S, Asahi S, Uematsu R, Matsumura S, Chatani F, Oda H. 2010. Advantages of human hepatocyte-derived transformants expressing a series of human cytochrome P450 isoforms for genotoxicity examination. *Tox Sci*, 116(2):488-97.

12. Hernandez F, Pitarch E, Serrano R, Gaspar JV, Olea N. 2002. Multiresidue determination of endosulfan and metabolic derivatives in human adipose tissue using automated liquid chromatographic cleanup and gas chromatographic analysis. *J Anal Toxicol* 26(2):94-103.
13. Jamil K, Shaik AP, Mahboob M, Krishna D. 2004. Effect of organophosphorus and organochlorine pesticides (monocrotophos, chlorpyriphos, dimethoate, and endosulfan) on human lymphocytes in-vitro. *Drug Chem Toxicol* 27(2):133-44.
14. Jia Z, Misra HP. 2007b. Exposure to mixtures of endosulfan and zineb induces apoptotic and necrotic cell death in SH-SY5Y neuroblastoma cells, in vitro. *J Appl Toxicol* 27(5):434-6.

15. Jia Z, Misra HP. 2007c. Reactive oxygen species in in vitro pesticideinduced neuronal cell (SH-SY5Y) cytotoxicity: role of NFkappaB and caspase-3. *Free Radic Biol Med* 42(2):288-98.
16. 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.
17. Kalender Y, Kalender S, Uzunhisarcikli M, Ogutcu A, Acikgoz F, Durak D. 2004. Effects of endosulfan on B cells of Langerhans islets in rat pancreas. *Toxicology* 200(2-3):205-11.
18. Kannan K, Holcombe RF, Jain SK, Alvarez-Hernandez X, Chervenak R, Wolf RE, Glass J. 2000. Evidence for the induction of apoptosis by endosulfan in a human T-cell leukemic line. *Mol Cell Biochem* 205(1-2):53-66.
19. Lafuente A, Cabaleiro T, Caride A, Romero A. 2006. Toxic effects of endosulfan on blood lymphocyte subset in adult rats. *Toxicol Letts* 164S:S234.
20. Lajmanovich RC, Cabagna M, Peltzer PM, Stringhini GA, Attademo AM. 2005. Micronucleus induction in erthrocytes of the *Hyla pulchella* tadpoles (Amphibia: Hylidae) exposed to insecticide endosulfan. *Mut Res* 587(1-2):67-72.
21. Liu W, Zhu L-S, Wang J, Wang J-H, Xie H, Yan Song Y. 2009. Assessment of the genotoxicity of endosulfan in earthworm and white clover plants using the comet assay. *Arch Environ Contam Toxicol* 56:742–746.
22. Lu Y, Morimoto K, Takeshita T, Takeuchi T, Saito T. 2000. Genotoxic effects of alpha-endosulfan and beta-endosulfan on human HepG2 cells. *Environ Health Perspect* 108(6):559–561.
23. Menone ML, Pesce SF, Dı _az MP, Moreno VJ, Wunderlin DA. 2008. Endosulfan induces oxidative stress and changes on detoxication enzymes in the aquatic macrophyte Myriophyllum quitense. *Phytochemistry* 69(5):1150-7.
24. Neuparth T, Bickham JW, Theodorakis CW, Costa FO, Costa MH. 2006. Endosulfan-induced genotoxicity detected in the Gilthead Seabream, *Sparus aurata* L., by means of flow cytometry and micronuclei assays. *Bull Environ Contam Toxicol* 76(2):242-8.
25. Pandey N, Gundevia F, Prem AS, Ray PK. 1990. Studies on the genotoxicity of endosulfan, an organochlorine insecticide, in mammalian germ cells. *Mutat Res* 242(1):1-7.
26. Pandey S, Nagpure NS, Kumar R, Sharma S, Srivastava SK, Verma MS. 2006. Genotoxicity evaluation of acute doses of endosulfan to freshwater teleost *Channa punctatus* (Bloch) by alkaline single-cell gel electrophoresis. *Ecotoxicol Environ Saf* 65(1):56-61.
27. Pérez DJ, Menone ML, Camadro EL, Moreno VJ. 2008. Genotoxicity evaluation of the insecticide endosulfan in the wetland macrophyte *Bidens laevis L. Environ Pollut* 153(3):695-8.

28. Sharma S, Nagpure NS, Kumar R, Pandey S, Srivastava SK, Singh PJ, Mathur PK. 2007a. Studies on the genotoxicity of endosulfan in different tissues of fresh water fish *Mystus vittatus* using the Comet assay. *Arch Environ Contam Toxicol* 53(4):617-23.
29. Silva MH, Beauvais SL. 2010. Human health risk assessment of endosulfan. I: Toxicology and hazard identification. *Regul Toxicol Pharmacol* 56 4–17.

30. Singh ND, Sharma AK, Dwivedi P. Patil RD, Kumar M. 2006. Citrinin and endosulfan induced teratogenic effects in Wistar rats. *J Appl Toxicol* 27(6):589-601.
31. Sobti RC, Krishan A, Davies J. 1983. Cytokinetic and cytogenetic effect of agricultural chemicals on human lymphoid cells in vitro II. Organochlorine pesticides. *Arch Toxicol* 52:221-31.
32. Yadav AS, Vashishat RK, Kakar SN. 1982. Testing of endosulfan and fenitrothion for genotoxicity in *Saccharomyces cerevisiae. Mutat Res* 105(6):403-7.

33. Wessel N, Rousseau S, Caisey X, Quiniou F, Akcha F. 2007. Investigating the relationship between embryotoxic and genotoxic effects of benzo[a]pyrene, 17*a*-ethinylestradiol and endosulfan on *Crassostrea gigas* embryos. *Aquat Toxicol* 85:133-42.

6. Carcinogenicity

1. Bedor CNG, Morais RJL, Cavalcani LS, Ferreira JV, Pavao AC. 2010. Carcinogenic potential of endosulfan and its metabolites based on a quantum chemical model. *Sci Total Environ* 408(24):6281-4.

2. Dorgan JF, Longcope C, Stephenson HE, Falk RT, Miller R, Franz C, Kahle L, Campbell WS, Tangrea JA, Schatzkin A. 1996. Relation of prediagnostic serum estrogen and androgen levels to breast cancer risk. *Cancer Epidemiol Biomark Prev* 5:533-9

3. Fransson-Steen R, Flodstrom S, Warngard L. 1992. The insecticide endosulfan and its two stereoisomers promote the growth of altered hepatic foci in rats. *Carcinogenesis* 13(12):2299-303
4. Ibarluzea JmJ, 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.
5. Laville N, Balguerf P, Brion F, Hinfray N, Casellas C, Porcher JM, Ait-Aissa S. 2006. Modulation of aromatase and mRNA by various selected pesticides in the human choriocarcinoma JEG-3 cell line. *Toxicology* 228(1):98-108.

Endosulfan affects immune system

. Immune System

1. Khurana SK, Chauhan RS. 1998. Immunotoxic effects of cypermethrin and endosulfan on macrophage functions of broiler chicks. *Indian J Anim Sci* 68:105–6.
2. Narita S, Goldblum RM, Watson CS, Brooks EG, Estes DM, Curran EM, Midoro-Horiuti T. 2007. Environmental estrogens induce mast cell degranulation and enhance IgE-mediated release of allergic mediators. *Environ Health Perspect* 115(1):48-52.
3. 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.
4. Abadin HG, Chou C-HSJ, F.T. Llados FT. 2007. Health effects classification and its role in the derivation of minimal risk levels: Immunological effects. *Reg Toxicol Pharmacol* 47:249–56.
5. Kurkure NV, Bhandarkar AG, Joshi MV, Sadekar RD, Bhagwat SS. 1993. Immunosuppressive and histotoxic effects of endosulfan in chicks. *Indian J Anim Sci* 63:1258–60.

Other studies:

1. EJF. 2002. End of the Road for Endosulfan: A Call For Action Against a Dangerous Pesticide. Environmental Justice Foundation, London. http://www.ejfoundation.org.
2. US EPA. 2007b. Endosulfan, The Health Effects Division's Addendum and Update to the 2002 Risk Assessment. Memorandum to Special Review and Reregistration Division. November 13. EPA-HQ-OPP- 2002-0262-0064. ttp://www.regulations.gov.
3. ERMANZ. 2007b. Application for Reassessment of a Hazardous Substance under Section 63 of the Hazardous Substances and New Organisms Act 1996. Name of substance: Endosulfan and Formulations containing Endosulfan. Environmental Risk Management Authority of New Zealand, Wellington. http://www.ermanz.govt.nz
4. GFEA-U. 2007. Endosulfan. Draft Dossier prepared in support of a proposal of endosulfan to be considered as a candidate for inclusion in the CLRTAP protocol on persistent organic pollutants. German Federal Environment Agency – Umweltbundesamt, Berlin.
5. Glin Lj, Kuiseau J, Thiam A, Vodouhe DS, Dinham B, Ferrigno S. 2006. *Living with Poison: Problems of Endosulfan in West Africa Cotton Growing Systems*. Pesticide Action Network UK, London.

6. Kelly BC, Gobas FAPC. 2003. An arctic terrestrial food-chain bioaccumulation model for persistent organic pollutants. *EnvironSci Total* 37(13):2966-74.
7. Kelly BC, Ikonomou MG, Blair JD, Morin AE, Gobas FAPC. 2007. Food web-specific biomagnification of persistent organic pollutants. *Science* 317:236-9.
8. NIOH. 2003. Final Report of the Investigation of Unusual Illnesses Allegedly Produced by Endosulfan Exposure In Padre Village of Kasargod District (N Kerala). National Institute of Occupational Health, Indian Council for Medical Research, Ahmedabad.
9. Quijano RF. 2000. Risk assessment in a third world reality: an Endosulfan case history. *Int J Occup Environ Health* 6(4):312-7.
10. Quijano RF. 2002. Endosulfan Poisoning in Kasargod, Kerala, India: Report on a Fact-Finding Mission. Pesticide Action Network Asia and the Pacific, Penang.

Based on these inclusion criteria, 3435 patients were identified as suspected by these camps. Their disease distribution was as follows:

However, it was identified that some patients were not able to make to the camps. In order to address this issue definite procedure was evolved for further inclusion of patients in the list of beneficiaries. This was as follows:

- **For already known patients (in earlier surveys):** house to house visits were conducted by Medical Officers of concerned PHCs to assess the condition (category) of the patients. By that another 838 patients were identified thus taking the total number of patients to 4273.
- **For patients not diagnosed already and neither able attend the camps:** a mechanism was established. A 10 member expert committee was formulated which consists of:

    1. Neurologist
    2. Physician
    3. ENT specialist
    4. Ophthalmologist
    5. Gynecologist
    6. Physiatrist
    7. Psychiatrist

8. Dermatologist
9. General surgeon
10. Orthopedic surgeon

The functions of this committee included the following:

- The committee conducts regular sittings at district hospital Kanhagad and GH Kasargode:
    a. Once in two months for initial 6 months, so that maximum number of genuine medical endosulfan patients can be identified, diagnosed and treated.
    b. There after yearly once for identifying new medical endosulfan patients.

The committee will examine the patients referred by the District Medical Officer (DMO).

The procedure of referral to the expert committee:

The snehasanthwanam cell in the district will receive applications from the patients and hand it over to DMO Kasagode. The DMO will order for enquiry in to these cases in a standard enquiry report form by the medical officer of concerned PHC or by the Mobile Medical Team. Based on the report the DMO will decide on whether a case should be referred to the committee or not.

As a result of this by February 28 we received 1097 complaints.

The first sitting of expert committee was conducted as follows:-

	Total of Patients
Kanhangad District Hospital 04 & 05th March 2011	494
Kasargod General Hospital 6th March 2011	244
Total	738
Total Number of patients identified as suspected endosulfan victim : 257	

257 of them were identified as suspected endosulfan victims based on clinical features. Their address verification completed and list submitted to District Collector for approval.

Benefits are now being provided only to the approved list of 4273 patient.

Distribution of diseases in the identified endosulfan victims:

		Out of the total identified cases (4273)
1.	Neurobehavioral and cognitive disorders	1624 (38%)
2.	Endocrine and reproductive disorders	641 (15%)
3.	Multiple congenital disorders (including skeletal deformities)	748 (17.5%)
4.	Allergic diseases, skin and respiratory illness	1145 (26.8%)
5	Cancers	342 (8%)
*Same patients can have multiple conditions		

2. Provision of comprehensive and free treatment to identified patients:

A comprehensive and sustainable mechanism is established to ensure appropriate and uninterrupted quality treatment and palliative care to the diagnosed patients. As part of this, following activities are underway and proposed for financial support.

2.1Treatment smart card:

2.2.1 **Overview:**

The rationale is to provide cashless treatment to Endosulfan victims of Kasargode at various hospitals empanelled for this project. Identifying the victims at empanelled hospitals will be done with the help of a smart card and online software accessible through internet, the server located at National Rural Health Mission. All the empanelled hospitals will have provision for login to the Software. Keltron is the nodal agency in providing the smart card and establishing the system.The complete personal data like Name, Address, Guardian Name, Photograph will be entered into the software application with a unique number.. All the relevant data will be encoded into the Smart card for future verification and Health History.

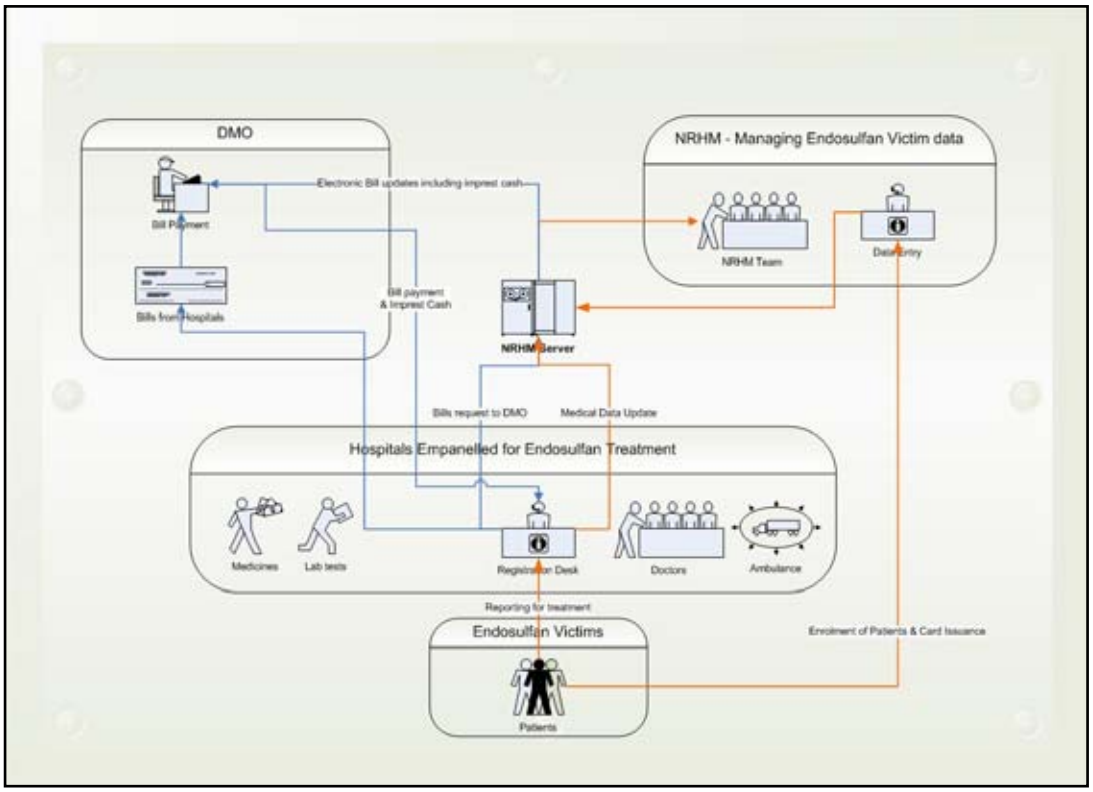
2.1.2 Functional Modules:

a) Admin Module with all reports.

b) NRHM Module - For Data Entry and Enrollment with reports.

c) Hospital Module - For Patient registration for Treatment and Billing module to claim the bills from DMO with reports.

d) DMO Module - For review the bills and Imprest cash and sanction accordingly with reports.



Overall flow diagram of smart card system:

Jeevan Raj and his brother (both of them are blind due to optic atrophy) with the treatment smart cards

Progress:

- Treatment smart card is already issued to 2800 patients. The rest of the cards will be issue by 30th April.
- Software for cashless treatment in empanelled hospitals is finalized and is being installed in the 11 empanelled hospitals.
- Trainings and orientation sessions for the implementation of these were conducted at NRHM, Trivandrum.

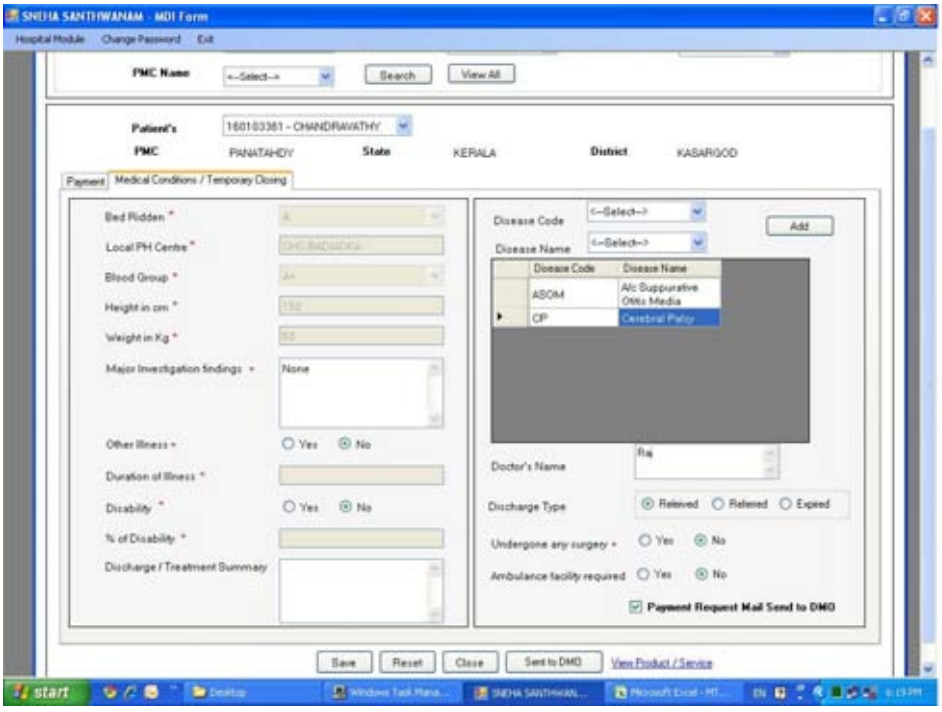
Schedule of trainings:

07.04.11	For Superintendent/RMOs of empanelled hospitals (over view on all modules – NRHM, DMO and Hospital Module)
08.04.11	For District Medical Officer of Health, Kasargod (On DMO Module)
11.04.11	For Public Relation Officers and Data Entry Operator (On Hospital module)

The patient can avail this service in all 11 empanelled hospitals from 15th April 2011.

However, while this is being implemented, the patients in the list who require emergency treatment are provided free treatment at all empanelled hospitals with a request letter from DMO. The payments for them are done promptly on receipt of the bills from the hospitals.

Screen shot of a window in 'snehasanthwanam' software.



List of empanelled Hospitals	
1	General Hospital, Kasragodu
2	District Hospital, Kanhagad
3	Pariyaram Medical College, Pariyaram
4	General Hospital, Thalassery
5	District Hospital, Kannur
6	Malabar Cancer Centre, Thalassery
7	W and C hospital, Mangatuparamba
8	Govt. Medical College, Calicut
9	ICCONS, Shornur
10	Regional Cancer Centre, Trivandrum
11	Sree Chithra Thirunal Institute for Science and Technology, Trivandrum

3. **Mobile Medical Units:**

3.1 Overview: for specialized home care for identified patients**.**

A full mobile medical team consists of:

a) one doctor each from Modern Medicine, Ayurveda and Homoeopathy

b) 1 Physiotherapist

c) 1clinical psychologist

d) 1 psychiatric social worker

e) 1 speech therapist

f) 1special trainer for mentally retarded person.

Progress made till date:

Three mobile medical units have been setup, so as to provide service six days in a month in each of 11 affected panchayats. (22 days for each team at their allotted area).

However only one of the team (called as major team) is provided with all the members in the team and the other two is having only a modern medicine doctor, one physiotherapist and one supporting staff.

Mobile medical team providing home care

4. Palliative care:

4.1 Overview:

The goal is to prevent and relieve suffering and to improve quality of life for people facing serious, complex illness. The Home Based Palliative Care team is intended to provide specialist nursing care and support to people with an advancing life limiting illness who choose to be cared for in their home environment.

Progress made till date:

- One vehicle for each panchayath has been provided for the palliative care team.
- Two additional staff nurses have been posted in each of 11 panchayats. They were provided specialized training in palliative care at Institute of Palliative Medicine (IPM) at Calicut. One of them will provide institution based palliative care while the other will cater home based care.
- One Physiotherapist has been posted in each panchayath for both home based care (apart from the mobile team) and institution based care.
- Additional medicines and equipments like catheters, BP apparatus are also provided to the palliative care team.

Palliative care team reaching for care

5. Strengthening of health service delivery system:

Health system preparedness in the affected panchayaths are getting improved and fine-tuned to cater to specific demands of the prevailing scenario.

Numerous improvements are proposed and in the process of implementation which includes:

5.1 Salary Incentives to Medical Staff:

Kasargode district is one of the least preferred regions in the state for doctors and other medical staff to work. Though the reason for this is multifaceted, additional incentives may be and has proved to be a motivating factor for doctors to work in this part of the state.

So it is proposed that salary incentive may be granted to doctors and other medical and paramedical staff, who chose to work in these endosulfan affected panchayats.

5.2 Physiotherapy units in PHC/ CHC:

Physiotherapist posted in the panchayath is provided with a physiotherapy unit at one CHC/PHC in the panchayath. The unit will have facilities for providing appropriate physiotherapy equipments for inpatient and outpatient service.

5.3 Modernization of GH and District Hospital:

- Kasargode General Hospital and Kanahghad District Hospital are two major Government hospitals in the district. Efforts are now on to upgrade the hospital with modern facilities. GH Kasargodu and DH Kanhagad are now provided with a full-fledged physiotherapy centre with Physiatrist, physiotherapist and modern equipments, advanced laboratory and other investigation facilities.
- A specialized unit for training of Mentally Retarted children are also functioning in GH kasargodu

5.4 Ambulance:

Ambulances with basic life support system including equipments like portable oxygen unit, portable suction unit, traction splints and spine board, would help for shifting the patients from home to referral hospital. Few ambulances with advanced life support including ventilator may be provided for shifting the patients between referral hospitals.

The ambulances may be provided in line with 108 emergency services, with a toll free number. As of now two ambulances with advanced facilities are provided to the district.

SOCIAL SECTOR

1. Compensation:

The families of the suspected endosulfan medical patients can be provided with one time compensation as follows:

Bedridden, seriously ill patients and patients who have already died	100,000 Rs
Other patients	50,000 Rs

Since 2006, 178 families are provided with a exgratia of 50,000 Rs. each.

2. Family pension:

Based on the condition and disease of the suspected endosulfan medical patents, they have classified in to three categories:

Category-I	- Bed ridden patient
Category-II	- Ambulant but requires assistance for routine activities
Category-III -	- Ambutant with minor disabilities.

Category 1 and 2 patients will receive a monthly pension of Rs. 2000 (inclusive of disability pension, if already available).

Category 3 patients will receive a monthly pension of Rs. 1000.

The Honorable Chief Minister inaugurating the family pension scheme

Progress:

Family Pensions for 3 months (January to March) sent as Money Order in patients address.

The distribution was as follows:

Category 1 & Category 2	` 2000 or ` 1700 (for those who already receive disability pension)
Category 3	` 1000

3. Loan write off:

As per the socio- economic survey conducted by the district administration through ICDS workers, it was estimated that about 3500 endosulfan affected families may have an average loan of Rs.50,000. The loans add to the misery of these families, who by now have spent massive amount on treatment of the suspected endosulfan medical patient in the family. So it is proposed and actions are on to write off their loans.

4. Centralized Residential relief and rehabilitation centre:

The demographic profile of these affected panchayats and the history of patients points to the facts that:

- Most of patients (often with severe disability) are cared by their aged mother or father who are also often affected by serious diseases. Their demise or inability to care will push the patient either to a phase of non-recovery, debilitation or even death.
- Caretakers are often unaware or incapable of providing quality care and assist patient in carrying out their daily activities.

These facts warrant the need for a comprehensive residential rehabilitation institution in the district.

5. Vocational training:

It is proposed to provide vocational rehabilitation for the handicapped person so as to enable him to secure suitable employment which he could retain and advance a permanent base with an ultimate aim of integrating or reintegrating him in the society.

6. Special school:

It is proposed to establish a day care cum residential school for children with Multiple Disabilities (i.e. Down Syndrome, Mental Retardation, Slow Learners, Learning Disability, etc.), Autism, Cerebral Palsy, Hearing Impairment, etc. for providing them with special training and education, featuring advanced teaching aids and through computer games and other activities. Their participation in various social & cultural programmes shall also be ensured.

Literature Review

Ecological effects of Endosulfan: studies

Fish:

As well as having caused massive fish kills in Africa and USA, endosulfan has a number of sublethal effects on fish

Fish kills:

1. Glin LJ, Kuiseau J, Thiam A, Vodouhe DS, Dinham B, Ferrigno S. 2006. Living with Poison: Problems of Endosulfan in West Africa Cotton Growing Systems. Pesticide Action Network UK, London.

2. PANNA. 1996. Endosulfan responsible for Alabama fish kill. PANUPS. Pesticide Action Network North America. http://www.panna.org.

3. 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.

4. GEF CAC. 2002. Regionally Based Assessment of Persistent Toxic Substances – Central America and the Caribbean Regional Report. Global Environment Facility, United Nations, Geneva. http://www.chem.unep.ch/Pts/.

Sublethal effects:

Genotoxic:

1. Sharma S, Nagpure NS, Kumar R, Pandey S, Srivastava SK, Singh PJ, Mathur PK. 2007. Studies on the genotoxicity of endosulfan in different tissues of fresh water fish *Mystus vittatus* using the Comet assay. *Arch Environ Contam Toxicol* 53(4):617-23.

2. Wessel N, Rousseau S, Caisey X, Quiniou F, Akcha F. 2007. Investigating the relationship between embryotoxic and genotoxic effects of benzo[a]pyrene, 17a-ethinylestradiol and endosulfan on *Crassostrea gigas* embryos. *Aquat Toxicol* 85:133-42.

3. Neuparth T, Bickham JW, Theodorakis CW, Costa FO, Costa MH. 2006. Endosulfan-induced genotoxicity detected in the Gilthead Seabream, *Sparus aurata L.*, by means of flow cytometry and micronuclei assays. *Bull Environ Contam Toxicol* 76(2):242-8.

Endocrine effects:

1. Sinha N, Lal B, Singh TP. 1991a. Effect of endosulfan on thyroid physiology in the freshwater catfish, *Clarias batrachus*. *Toxicology* 67(2):187-97.

2. Sinha N, Lal B, Singh TP. 1991b. Pesticides induced changes in circulating thyroid hormones in the freshwater catfish *Clarias batrachus*. *Comp Biochem Physiol C* 100(1-2):107-10.

3. Park D, Minor MD, Propper CR. 2004. Toxic response of endosulfan to breeding and non-breeding female mosquitofish. *J Environ Biol* 25(2):119-24.

4. Coimbra AM, Reis-Henriques MA, Darras VM. 2005. Circulating thyroid hormone levels and iodothyronine deiodinase activities in Nile tilapia (*Oreochromis niloticus*) following dietary exposure to Endosulfan and Aroclor 1254. *Comp Biochem Physiol C Toxicol Pharmacol* 141(1):8-14.

Reproductive:

1. Willey JB, Krone PH. 2001. Effects of endosulfan and nonylphenol on the primordial germ cell population in pre-larval zebrafish embryos. *Aquat Toxicol* 54(1-2):113-23.

2. Dutta HM, Misquitta D, Khan S. 2006. The effects of endosulfan on the testes of bluegill fish, *Lepomis macrochirus*: a histopathological study. *Arch Environ Contam Toxicol* 51(1):149-56.

3. Singh PB, Singh V, Nayak PK. 2008b. Pesticide residues and reproductive dysfunction in different vertebrates from north India. *Food Chem Toxicol* 46(7):253-9.

4. Gormley KL, Teather KL. 2003. Developmental, behavioral, and reproductive effects experienced by Japanese medaka (*Oryzias latipes*) in response to short-term exposure to endosulfan. *Ecotox Environ Saf* 54:330-38.

5. Holdway DA, Hefferman J, Smith A. 2008. Multigeneration assessment of nonylphenol and endosulfan using a model Australian freshwater fish, *Melanotaenia fluviatilis*. *Environ Toxicol* 23(2):253-62.

Amphibia:

Highly toxic to a number of amphibia and is implicated in declining populations:

1. Relyea R. 2008. A cocktail of contaminants: how mixtures of pesticides at low concentrations affect aquatic communities. *Oecologica* 159(2): 363-76.

2. Sparling DW, Fellers GM. 2009. Toxicity of two insecticides to California, USA, anurans and its relevance to declining amphibian populations. *Environ Toxicol Chem* 28(8):1696–1703.

3. Sparling DW, Fellers GM, McConnell LL. 2001. Pesticides and amphibian population declines in California USA. *Environ Toxicol Chem* 20(7):1591-95.

4. Bernabo I, Brunelli E, Berg C, Bonacci A, Tripepi S. 2008. Endosulfan acute toxicity in Bufo bufo gills: Ultrastructural changes and nitric oxide synthase localization. *Aquat Toxicol* 86:447–56.

5. Kang HS, Gye MC, Kim MY. 2008. Effects of endosulfan on survival and development of *Bombina orientalis* (Boulenger) embryos. *Bull Environ Contam Toxicol* 81:262–5.

6. Jones DK, Hammond JI, Relyea RA. 2009. Very highly toxic effects of endosulfan across nine species of tadpoles: lag effects and family-level sensitivity. *Environ Toxicol Chem* 28(9):1939–45.

Sublethal concentrations also affect survival:

1. Broomhall S. 2002. The effects of endosulfan and variable water temperature on survivorship and subsequent vulnerability to predation in *Litoria citropa* tadpoles. *Aquatic Toxicol* 61:243-50.

2. Broomhall S, Shine R. 2003. Effects of the insecticide endosulfan and presence of congeneric tadpoles on Australian tree frog (*Litoria freycineti*) tadpoles. *Arch Environ Contam Toxicol* 45(2):221-26.

3. Park D, Hempleman SC, Propper CR. 2001. Endosulfan exposure disrupts pheromonal systems in the red-spotted newt: a mechanism for subtle effects of environmental chemicals. *Environ Health Perspect* 109:669–73.

4. Park D, Propper CR. 2002. Endosulfan affects pheromonal detection and glands in the male red-spotted newt, *Notophthalmus viridescens*. *Bull Environ Contam Toxicol* 69:609-16.

5. 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.

Wildlife poisoning:

GEF SSA. 2002. Regionally Based Assessment of Persistent Toxic Substances – Sub-Saharan Africa Regional Report. Global Environment Facility, United Nations Environmental Programme, Geneva. http://www.chem.unep.ch/Pts/.

Birds:

Endosulfan suppresses the immune system in birds:

1. Bhattacharya S, Gosh RK, Mandal TK, Chakraborty AK, Basak DK. 1993. Some histological changes in chronic endosulfan (Thionol) toxicity in poultry. *Indian J Anim Health* 32:9–11.

2. 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.

3. Kurkure NV, Bhandarkar AG, Joshi MV, Sadekar RD, Bhagwat SS. 1993. Immunosuppressive and histotoxic effects of endosulfan in chicks. *Indian J Anim Sci* 63:1258–60.

4. Khurana SK, Chauhan RS. 1998. Immunotoxic effects of cypermethrin and endosulfan on macrophage functions of broiler chicks. *Indian J Anim Sci* 68:105–6. AM. 2005.

5. Pushpanjali, Pal AK, Prasad RL, Prasad A, Singh SK, Kumar A, Jadhao SB. 2005. In ovo embryotoxicity of a-endosulfan adversely influences liver and brain metabolism and the immune system in chickens. *Pestic Biochem Physiol* 82:103–14.

Bees:

As well as being toxic to bees, endosulfan has sublethal effects on bees:

1. Decourtye A, Devillers J, Genecque E, Le Menach K, Budzinski H, Cluzeau S, Pham-Delegue MH. 2005. Comparative sublethal toxicity of nine pesticides on olfactory learning performances of the honeybee *Apis meillifera*. *Arch Environ Contam Toxicol* 48(2):242-50.

Beneficial Insects:

Endosulfan is highly toxic to a number of beneficial insects and is not suitable for IPM

1. Bastos CS, de Almeida RP, Suinaga FA. 2006. Selectivity of pesticides used on cotton (Gossypium hirsutum) to Trichogramma pretiosum reared on two laboratory-reared hosts. *Pest Manag Sci* 62:91–8.

2. Bostanian NJ, Akalach M. 2004. The contact toxicity of indoxacarb and five other insecticides to *Orius insidiosus* (Hemiptera: Anthocoridae) and *Aphidius colemani* (Hymenoptera: Braconidae), beneficials used in the greenhouse industry. *Pest Manag Sci* 60(12):1231-6.

3. Bostanian NJ, Akalach M. 2006. The effect of indoxacarb and five other insecticides on *Phytoseiulus persimilis* (Acari: Phytoseiidae), *Amblyseius fallacis* (Acari: Phytoseiidae) and nymphs of *Orius insidiosus* (Hemiptera: Anthocoridae). *Pest Manag Sci* 62:334–9.

4. Elzen GW. 2001. Lethal and sublethal effects of insecticide residues on *Orius insidiorus* (Hemiptera: Anthocoridae) and *Geocoris punctipes* (Hemiptera: Lygaeidae). *J Econ Entomol* 94(1):55-9.

5. Schneider MI, Pineda P, Smagghe G. 2006. Side effects of conventional and non-conventional insecticides on eggs and larvae of *Chrysoperla externa* (Hagen) (Neuroptera: Chrysopidae) in Argentine. *Commun Agric Appl Biol Sci* 71(2 Pt B):425-7.

6. Benamú MA, Schneider MI, Pineda S, Sanchez NE, Gonzalez A. 2007. Sublethal effects of two neurotoxican insecticides on *Araneus pratensis* (Araneae: Araneidae). *Commun Agric Appl Biol Sci* 72(3):557-9.

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Countries that Have Banned, Are Phasing Out, Don't Use, or are Still Using Endosulfan.

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COUNTRIES THAT HAVE BANNED OR ARE PHASING OUT			
	COUNTRY	**DATE**	**PHASE-OUT**
1	Australia	2010	2 years
2	Austria	2005	6 months
3	Bahrain	pre-2008	info supplied to POPRC in 2008
4	Belgium	2005	6 months
5	Belize	1985	
6	Benin	2008	
7	Brazil	2010	3 years
8	Bulgaria	2005	6 months
9	Burkina Faso	2007	1 year
10	Canada	2010	6 years
11	Cambodia		
12	Cameroon	2008	
13	Cape Verde	2007	1 year
14	Colombia	pre 2002	
15	Cote d'Ivoire	2004 notification to PIC	
16	Croatia	2007	
17	Cyprus	2005	6 months

18	Czech Republic	2005	6 months
19	Denmark	2005	6 months
20	Egypt	1996	
21	Eritrea		
22	Estonia	2005	6 months
23	Fiji		
24	Finland	2005	6 months
25	France	2005	6 months
26	Gambia	2007	1 year
27	Germany	2005	6 months
28	Greece	2005	6 months
29	Guinea Bissau	2007	1 year
30	Hungary	2005	6 months
31	Indonesia	2002	
32	Ireland	2005	6 months
33	Italy	2005	6 months, except for derogation on hazelnuts
34	Iran	2008	
35	Jamaica	2010	end of stocks
36	Japan	2010	
37	Jordan	1994	
38	Kenya		
39	Korea	2010	end of 2011
40	Kuwait		
41	Latvia	2005	6 months
42	Lebanon	2010	6 months or till stocks used
43	Liechtenstein		
44	Lithuania	2005	6 months

45	Luxembourg	2005	6 months
46	Malaysia	2005	
47	Malawi	2010	
48	Mali	2007	1 year
49	Malta	2005	6 months
50	Mauritius	pre-2008	Notification to POPRC
51	Mauritania	2007	1 year
52	Morocco	2010	6 months
53	Netherlands	2005	6 months
54	New Zealand	2008	1month
55	Niger	2007	1 year
56	Nigeria	2008	
57	Norway	1999	
58	Oman		
59	Paraguay	2010	
60	Poland	2005	6 months
61	Portugal	2005	6 months
62	Qatar		
63	Romania	2005	6 months
64	Saudi Arabia		
65	Senegal	2007	1 year
66	Seychelles	1995	
67	Singapore		
68	Slovakia	2005	6 months
69	Slovenia	2005	6 months
70	Spain	2005	6 months
71	Sri Lanka	1998	

72	St Lucia		
73	Sweden	2005	6 months
74	Switzerland	2009	
75	Syria	1990	
76	Tchad	2007	1 year
77	Tunisia		
78	United Arab Emirates	pre-2009	
79	United Kingdom	2005	6 months
80	USA	2010	6 years
81	Venezuela	2009	

	NOT Permitted, but not banned
1	Armenia
2	Azerbaijan
3	Belarus
4	Georgia
5	Kazakhstan
6	Krygystan
7	Moldova
8	Russia
9	Tarjikistan
10	Turkmenistan
11	Ukraine
12	Uzbekistan

STILL LEGALLY USING AND NO PHASE-OUT ANNOUNCED	
1	Argentina
2	Botswana
3	Burundi
4	Chile
5	China
6	Costa Rica
7	El Salvador
8	Ethiopia
9	Ghana
10	Guatemala
11	Honduras
12	India
13	Israel
14	Lesotho
15	Madagascar
16	Mexico
17	Mozambique
18	Nepal
19	Pakistan
20	Sierra Leone
21	South Africa
22	Sudan
23	Tanzania
24	Uganda
25	Uruguay
26	Zambia

endosulfan victims

endosulfan victims