ENDOSULFAN:

HEALTH VERSUS WEALTH

Travail de Maturité

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Image 1-4: by Grace Kurian, and image 5 from the Government of Kerala

Dedicated to all the people who are disabled, maimed and suffering because of past endosulfan use in India

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I. Introduction

Important issues related to food production, agriculture and pesticides have not been highlighted in the past few years, with the limelight being stolen by issues on global security or natural disasters. However the fact remains that human beings need to eat, and they are competing with other species to access food. In agriculture, combatting pests has been practiced since 1500 BC, when Egyptians made insecticides to stop lice, fleas and wasps. The Greek poet Homer even talks about using sulphur. This trend has remained until the current times.[1] We now use synthesised chemicals to limit the damage caused by pestilent organisms, and thus stay on top of the food chain - but to what extent does that competition go?

For my *Travail de Maturité,* I wanted to study a problem with multiple facets reflecting the complexities of the real world. I looked in the field of health, being inspired by my parents. In my quest, I found many irrationalities. For instance, the extent to which human beings disregard the natural environment creating hazards for themselves, even though they dearly value their health and are willing to pay huge amounts of money for its treatment and research.

Agriculture is a fundamental aspect of human society since food is essential for survival. It is necessary to reflect about the food we eat; Where does it comes from? How is it grown? How nutritious is it? What is the impact of agriculture and food production on the environment? The importance of such enquiry and analysis cannot be overemphasised, especially in a world where population is rising and where a significant portion of humanity has limited access to food. Modern agriculture actively uses pesticides. Organic farming, which prohibits the use of synthesised chemicals, is not widespread. Therefore exposure to these chemicals is evident and extensive. In many countries, including India, no one is able to avoid the chemical residue that has been used in agriculture since the 1950s and is still used today. Nevertheless the impact of the use of certain pesticides hasn't been fully studied or researched and many people are beginning to understand that along with increases in yield, humans are exposed to massive doses of toxins in the form of pesticides. One such pesticide is endosulfan which has been used in agriculture around the world to control insect pests.

The use of endosulfan in the district of Kasargod in the state of Kerala, India was a subject that I came across when I was considering the Environmental Health situation in India. I chose it for my "*Travail de Maturité*" because there were recent media highlights that seemed quite relevant to me. However, it was only when I properly started researching the issue that I realised how difficult it was to find true facts. Not knowing the extent of endosulfan use in the region, its consequences or the seriousness of its impact, my only certainty was that the media had talked about it, and that it affected the general population in Kasargod, a district in Northern Kerala. Many contradicting articles kindled my curiosity to understand the theoretical aspects of pesticide use before delving into the situation in Kasargod.

My first step was to interview an Indian medical doctor working in the region affected by endosulfan over the telephone. My naive expectations for clear explanations were crushed. To my disappointment, the doctor seemed unclear about the certainty of the relationship between endosulfan use and the so-called adverse effects the pesticide had on the population. I then realised that I had to do more research on the subject, perhaps visit the region, in order to meet the stakeholders such as the agriculturalists, doctors or activists involved in this issue to gain a deeper understanding of it.

I visited the state capital, Thiruvananthapuram and the affected district, Kasargod during my visit to Kerala between 8th and 15th July 2013. I was confident that thanks to my roots in Kerala, my ability to speak the local language, Malayalam, which is also my mother-tongue, I would be able to get a better understanding of the situation. On discussing with the affected populace in Kasargod, I quickly realised how unique a case study I had stumbled upon. Endosulfan is one of the most toxic pesticides , responsible for many fatal pesticide poisoning incidents around the world. During my visit to Kerala, I had the privilege of meeting the activists who were fully involved in initiating and mobilising the social movement and protest that resulted in the Stockholm Convention classifying endosulfan as a Persistent Organic Pollutant (POP) in 2011 and subsequently led to a worldwide ban in 2012.

The research suddenly became a story of how an environmental movement had made history. The ban changed my view on the impact ordinary people can have in society and made me realise that sometimes, despite all the complexities and challenges, it is possible to contribute to change and ultimately transform people's lives for the better.

Picture 1: Cashew plantation in Kasargod
by Grace Kurian

II. Statement of the problem

Question 1: How can we justify the use of a toxic pesticide that harms human beings, along with the environment?

Question 2: Can the use of such pesticides be avoided without compromising on agricultural yield?

Hypothesis: Endosulfan is a pesticide that is highly toxic to the environment, biodiversity and to the health of human beings. However it has been used for economic reasons for many decades and only phased out globally by the end of 2012. My hypothesis is that it is possible to have alternative methods of agriculture which would not harm human health and the environment, and which could be used to have similar yield.

In order to answer these questions, I based my project on endosulfan use in cashew plantations in the region of Kasargod, Kerala. Through this study I wanted to understand why pesticides are causing problems, whether using them is fundamentally necessary and who made the decisions for their use. I will limit my research to the region of Kasargod, and will not discuss the effects of endosulfan use in other parts of the world.

I will be basing myself on the design of a descriptive study, which is usually done to examine different disease rates in a population in relation to age, gender and other factors including the environmental conditions. These studies aim to identify trends in disease occurrence and are useful to generate further research. [2]

Thankfully endosulfan was banned, shortly before I started the research, so the debates, allegations and counter-allegations between interest groups had settled down and my questions were received more objectively by all concerned.

The questions that I addressed in my project are the following: What is endosulfan? What is its role in modern agriculture? Why is its use dangerous? How are human beings harmed by the chemical? What were the justifications to use a dangerous pesticide? How was the ban made possible, after many years of use? What are the lessons that we can learn from this issue?

I have attempted to understand the facts, using the information from the internet, scientific reviews, personal interviews and a field visit, and to derive reasonable conclusions on the issue of pesticide use and its hazards.

III. The Methods

Bench review: A basic understanding of the subject was achieved thanks to the use of Internet and several books that dealt with the subject of pesticides. For more accurate information concerning endosulfan, I was also able to collect factual and verifiable data from India.

Site visit: I visited the Non-Governmental Organisation THANAL, which is an environmental organisation based in Kerala that has been working on a number of issues of public interest especially related to the environment, agriculture and livelihood generation, and that primarily does research, advocacy, action and education.This visit enabled me to have a clear picture of the situation in Kasargod, the northernmost district of Kerala State. This was followed by a field visit: I travelled to the region of Kasargod, where I was able to meet many of the local activists who had played crucial roles in the movement against endosulfan. I visited a rural health clinic and the cashew plantations in the hilly region. My final visit in India was to the Non-Governmental Organisation the '*Society for Community Health Awareness Research and Action*' (SOCHARA) in the city of Bangalore, Karnataka State, where I was able to understand the notion of Environmental Health in India.

In depth interviews: I conducted a number of in-depth interviews of the key stakeholders in endosulfan use in Kasargod. The following people were interviewed:

1. M. Jayakumar C., a zoologist by training, one of the founders of THANAL (Non Governmental Organisation for the environment, and protection of traditional agriculture), in Kerala. He is an active representative of Civil Society movements at the Stockholm Convention on Persistent Organic Pollutants. Interviewed in English with notes and recordings on 9th July 2013.

2. Sreemati Leelakumari, agricultural specialist and first person to have filed a legal case against the use of endosulfan in Kasargod.Interviewed in Malayalam with notes on 13th July 2013.

3. Dr. M. Asheel, MBBS, MPH, MDP a Public Health doctor who argued the case against endosulfan, Asst. Nodal Officer Rehabilitation of Endosulfan Victims Govt. of Kerala. Interviewed in English with notes and recordings on 13th July 2013.

4. Prof. M A Rahman, documentary producer, writer, Social activist and retired Professor. Interviewed in Malayalam with notes, on 13th July 2013.

5. Prof. G B Valsan , writer, retired Professor and Social activist. Interviewed in Malayalam with notes, on 13th July 2013.

6. Dr. Y. S Mohan Kumar., MBBS, who works in three primary health centres in the affected region of Kasargod for more than 30 years. Interviewed in English with notes on 14th July 2013.

7. Dr. A Pradyumna, MBBS, MSc Public Heath, responsible for research and training interests in Environmental Health and Epidemiology, SOCHARA, Bangalore, India. Interviewed in English with notes and recording, on 30th July 2013.

IV. Theoretical Concepts

A) Pesticide Classification

Pesticides are substances used to optimise the yield in agriculture by preventing pests from destroying crop. The World Health Organisation gives this definition:

"Pesticides are chemical compounds that are used to kill pests, including insects, rodents, fungi and unwanted plants (weeds). Pesticides are used in public health to kill vectors of disease, such as mosquitoes, and in agriculture, to kill pests that damage crops. By their nature, pesticides are potentially toxic to other organisms, including humans, and need to be used safely and disposed of properly." [3]

Chemical pesticides that target insects are generally classified into four groups: [4]

1. Organophosphate Pesticides which affect the nervous system: it modifies the regulation of a neurotransmitter called acetylcholine by disrupting its regulating enzyme. Most organophosphates are insecticides, and they affect humans and insects in a similar manner. These substances have different degrees of toxicity but are usually not persistent in the environment.

2. Carbamate Pesticides have the same effect as organophosphate pesticides on the nervous system, except that for their effects are reversible. There are also different subclasses of carbamates.

3. Organochlorine Pesticides are very toxic and many of them are non-biodegradable. They have significant long-term effects on health and the environment and therefore are not supposed to be on the market anymore. However, they have often been used in the past century, before many of the side effects were described, and before people realised they were highly persistent in the environment.

4. Pyrethroid Pesticides are a synthetic version of the natural pesticide pyrethrin, which is found in the chrysanthemum flower. They have been developed and modified in order to remain stable in the environment. It is important to note that some pyrethroids can also be toxic to the nervous system.

Furthermore, pesticides are distinguished depending on their function. For example, a chemical that should be eradicating insects is called an insecticide, fungi is called fungicide and so on. Some pesticides can have many functions (broad spectrum) and are used to be able to target many "pests".
(See Figure A: List of pesticide functions and examples of their targets- Annex 1)

a) Organochlorine pesticides

Organochlorines, or chlorinated hydrocarbons, is a class that represents a variety of compounds which contain hydrogen, chlorine and carbon. These compounds can be toxic and this is the reason most of them are banned. The compounds can be separated into five subgroups: [5]

1. Dichlorodiphenyltrichloroethane (DDT) and analogues (dicofol, methoxychlor)
2. Hexachlorocyclohexane (ibenzene hexachloride) and isomers (lindane, gamma-hexachlorocyclohexane)
3. Cyclodienes (endosulfan, chlordane, heptachlor, aldrin, dieldrin, endrin, isobenzan)
4. Chlordecone, kelevan, and mirex
5. Toxaphene

b) Cyclodienes

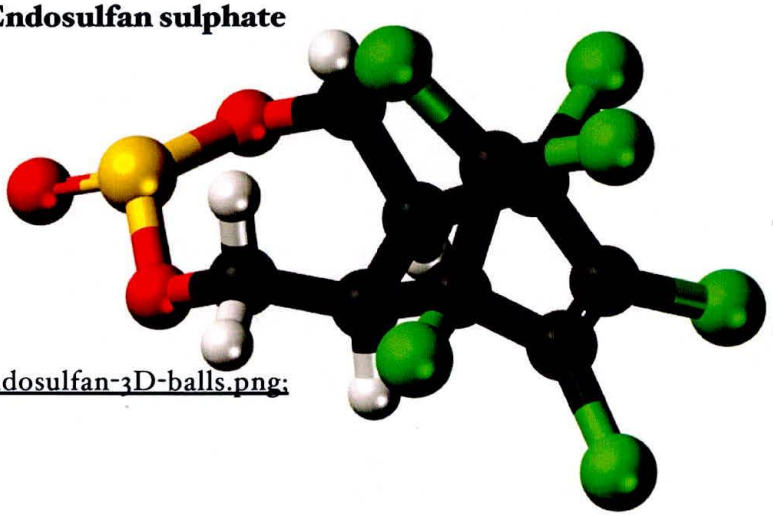
Each of these Organichlorine pesticides have different chemical structures. I will only detail the cyclodiene endosulfan since my main interest is this chemical.
Another infamous cyclodiene is DDT, or dichlorodiphenyltrichloroethane, which was thought to have been the solution against harmful insects. It is harmful to the environment and human health- it is toxic to birds and fish and can cause interference with the reproductive system. For humans, DDT is still considered a potential cancer agent. Since the development of this pesticide in the 1940s until its ban in 1972, it is estimated that 675 000 tons of DDT had been used in the United States of America alone- there are still traces of residue in food supply, the environment and human tissue including breastmilk, although it was discontinued more than 40 years ago.[6]

c) Endosulfan

Endosulfan, now considered a Persistent Organic Pollutant (POP), is a carbon containing substance which resists photochemical, biological and chemical degradation. It is listed on the list of banned substances of the Stockholm Convention. *(See Legislation of pesticides)*.

Figure 1: Ball and Stick model of the Endosulfan sulphate

- Black: Carbon, C
- White: Hydrogen, H
- Red: Oxygen, O
- Yellow: Sulfur, S
- Green: Chlorine, Cl



source: http://en.wikipedia.org/wiki/File:Endosulfan-3D-balls.png; 23.10.13; 19:32

Endosulfan is an organochlorine molecule. In physical form, endosulfan is available in two distinct forms called α- and β-endosulfan. The mixture of the two is usually 2:1 to 7:3. The α- endosulfan has two twist chair forms, but the β-endosulfan is symmetric. The β-endosulfan easily converts to α- endosulfan, but not vice-versa.[7] It appears cream or brown in colour, is most commonly found as crystalline or flaky substance. It has a smell that resembles that of turpentine and is heat resistant (not combustible). However, when oxidised, the α- and β- isomers become endosulfan sulphate, which is even more persistent[6a]. *(See Figure B and C, Annex 1)*

B) Endosulfan Safety Precautions

Endosulfan is meant to be used with caution and is labeled as a toxic substance. It should be sprayed maximum two times on a hectare of plantations, and should not be applied on waterlogged soil, unless the excess water can be captured .The instructions specify that for cashew crops, the harvesting should not be done for 14 days after the spraying. [6b]

C) Basic Toxicology Principles

In toxicology, two of the most important concepts are dose and response. A dose is the quantity in mg of a substance for one kg (of an organism). The higher the dose, the more dangerous the effects, even more dangerous to a smaller body weight (e.g. a child). The response can be immediate or can be a result of cumulative exposure. Therefore a substance can appear to be harmless at first but can present risks after a long period of time.

A term that is often used to compare the toxicity of different agents is LD50 [mg/kg] (or Median Lethal Dose). This is the dose that results in the the death of 50% of subjects of a tested population after a specified test duration.

WHO Class		LD_{50} for the rat (mg/kg body weight)	
		Oral	Dermal
Ia	Extremely hazardous	< 5	< 50
Ib	Highly hazardous	5–50	50–200
II	Moderately hazardous	50–2000	200–2000
III	Slightly hazardous	Over 2000	Over 2000
U	Unlikely to present acute hazard	5000 or higher	

Figures 2: Classification of pesticides

source: The WHO recommended classification of Pesticide by Hazard, and Guidelines to classification 2009, International Programme on Chemical Safety (IPCS) (http://www.who.int/ipcs/publications/pesticides_hazard/en/ ; 23.10.2013; 11:06)

Table 3.1. Endocrine disrupting chemicals (EDCs) can be grouped in multiple ways. In this table known or potential EDCs are grouped into 1 categories with examples of individual EDCs. Bolded chemicals were selected since they are regarded to be of specific interest as EDCs, nd are described in more detail in the text

Classification	Specific Examples of EDCs[1]
Persistent and bioaccumulative halogenated chemicals	
Persistent Organic Pollutants (POPs) (Stockholm Convention) (section 3.1.1.1)	PCDDs/PCDFs, **PCBs**, HCB, **PFOS**, **PBDEs**, PBBs, Chlordane, Mirex, Toxaphene, **DDT**/DDE, Lindane, Endosulfan
Other Persistent and Bioaccumulative Chemicals (section 3.1.1.2)	**HBCDD**, SCCP, PFCAs (e.g. **PFOA**), Octachlorostyrene, PCB methyl sulfones
Less persistent and less bioaccumulative chemicals	
Plasticizers and Other Additives in Materials and Goods (section 3.1.1.3)	Phthalate esters (**DEHP**, BBP, DBP, DiNP), Triphenyl phosphate, Bis(2-ethylhexyl)adipate, n-Butylbenzene, Triclocarban, Butylated hydroxyanisole
Polycyclic Aromatic Chemicals (PACs) including PAHs (section 3.1.1.4)	**Benzo(a)pyrene**, Benzo(a)anthracene, Pyrene, Anthracene
Halogenated Phenolic Chemicals (HPCs) (section 3.1.1.5)	2,4-Dichlorophenol , Pentachlorophenol, Hydroxy-PCBs, Hydroxy-PBDEs, Tetrabromobisphenol A, 2,4,6-Tribromophenol, **Triclosan**
Non-halogenated Phenolic Chemicals (Non-HPCs) (section 3.1.1.5)	**Bisphenol A**, Bisphenol F, Bisphenol S, Nonylphenol, Octylphenol, Resorcinol

Figure 3: Classification of endosulfan as a Persistent Organic Pollutant

source: State of the science of endocrine disrupting Chemicals, 2012, WHO, (http://www.who.int/ceh/publications/endocrine/en/; 23.10.12: 11:32), Presented in Dr. Asheel's sources

D) World Health Organisation (WHO) Recommended Classification of Pesticides

The WHO set up a classification of pesticides in the World Health Assembly in Geneva in 1975, determining which are the less hazardous pesticides and which are more. It is based on the LD50 [mg/kg], for mice and has been determined for oral doses and dermal doses. [8]

Formerly, endosulfan had been described by the WHO as a moderately hazardous pesticide which is also an organochlorine. However, it has been reviewed several times and is considered extremely hazardous by the Food and Agriculture Organisation (FAO), highly hazardous by the European Union and the United States Environment Protection Agency (EPA) [9] [10].

Since the last revision by the WHO, endosulfan is called an endocrine disruptor, and has been admitted to be a Persistent Organic Pollutant (POP) [11]

V. The Health Hazards of Endosulfan

Most of the More Economically Developed Countries (MEDCs) have replaced organochlorines by more easily biodegradable pesticides, whereas there is still production and usage of such pesticides in many Less Economically Developed Countries (LEDCs). This has resulted in problems such as leakage of unsealed stockpiles (with documented occurrences in many parts of Asia and the Pacific Islands). The resultant unnecessary exposure and contamination has increased the risk of cancer (UNEP 2002a,b,d) [12] and other exposure-related health problems. Studies have shown that pesticide contamination maximally affects people in the agriculture sector. The rate of exposure in these people is second only to those working in the industry. (Brophy et al 2002) [13] Persistent and widespread dispersal of organochlorines in the environment has an important gender effect affecting women and reproduction all over the world through the food chain contamination.[14]

A) Endosulfan contamination

Like all other organochlorines, endosulfan persists in the environment, in food, in wildlife and in human bodies. As part of the first generation of pesticides used worldwide, organochlorines were particularly used in huge quantities, which resulted in a worldwide environmental contamination. (PAN Int 2007) [15]

Endosulfan has been among the most extensively used organochlorines in the past 60 years, since it had been made available in the 1950s. As the negative impact became increasingly evident many

countries discontinued endosulfan use by the end of the the 20th century and its use was finally banned worldwide in 2012. *(See Chapter IX on Legislation)*

Traces of endosulfan have been found in breast milk, adipose tissue, placental tissue, and umbilical cord blood (Cerrillo 2005) [16]

Traces in breast-milk have been observed in countries such as Australia, Cambodia, China, India, Indonesia, Iran, Israel, Japan, Jordan, Kazakistan, Kuwait, Kyrgistan, Malaysia, New Zealand, Pakistan, Papua New Guinea, Samoa, Saudi Arabia, Sri Lanka, Taiwan, Tajikistan, Thailand, Turkey, Turkmenistan and Viet Nam. [17]

In 2005, infants in Bhopal, India absorbed 8.6 more times endosulfan that the average daily intake levels recommended by the WHO. (Sanghi et al 2003)[18]

Figure 2: Pictures in the Government of Kerala report

source:Endsulfan: the Kerala Story, http://www.cseindia.org/userfiles/endosulfan_kerala_story.pdf; 28.10.13; 02:00, (p. 37), also present in Dr. Asheel's sources

B) Effects of Endosulfan contamination

1. Nervous System Damage

Endosulfan mainly affects mammalian brains by attaching itself to the receptor of the GABA (gamma-aminobutyric acid) neurotransmitter. It is a non-competitive antagonist, that stops the neuron from polarising back to its resting potential,the nerve cell therefore remaining in an uncontrollably excitable state. (UNEP/FAO 2007, PAN endosulfan document) [19] [20]

2. Disruption of Immune Function

The human Natural Killer T-cells are induced to cell death by endosulfan, which means that the T-cells meant to regulate the health of normal cells are suppressed, giving more potential for the development of cancer. [21]

3. Endocrine Disruption

The endocrine system deals with the production and control of hormones in the human body. Endosulfan is an endocrine disruptor since it is oestrogenic, and causes the proliferation of MCF-7 human

oestrogen sensitive breast-cancer cells.There are many ways in which pesticides encourage the proliferation of these cells, but usually it involves the mimicking of the oestrogen hormone, creating the growth of oestrogen-dependent breast tumours. There is strong evidence from in-vitro laboratory tests for this process. (e.g. Soto et al 1991; Bonefeld Jorgensen et al 2005). Furthermore endosulfan is anti-androgenic, which means that the androgenic hormone is suppressed, and it is suggested that this too causes an increase in risks of breast tumours (Andersen et al 2002; Kojima et al 2004). [22]

Even in situations where endosulfan exposure is at very low concentrations, it can cause breast cancer because of its interference with a number of hormonal mechanisms.

Women are greatly vulnerable to pesticides, and this is often not taken into account in toxicological risk assessment. Pesticide residue is mostly stored in fat, and since women have a higher proportion of body fat, pesticides which are hormonally active (called endocrine disruptors) profoundly change the hormonally-sensitive tissue, causing breast tumours during pregnancy and lactation . The fact that natural hormonal changes occur in a cyclic nature (menstruation) add to the risks. [23]

4. Carcinogenicity

Although endosulfan is not classified by the International Agency for the Research on Cancer (IARC), an organisation affiliated to the World Health Organisation, as a carcinogen, there have been many independent studies which have found the substance to be carcinogenic (Reuber 1981), genotoxic to bacteria (e.g. Chaudhuri et al 1999) and to human cells (Jamil et al 2004; Lu et al 2000) and to mouse cells (Pandey et al 1990), a tumour promoter (Fransson-Steen 1992) and a mutagenic (Yadav et al 1982).

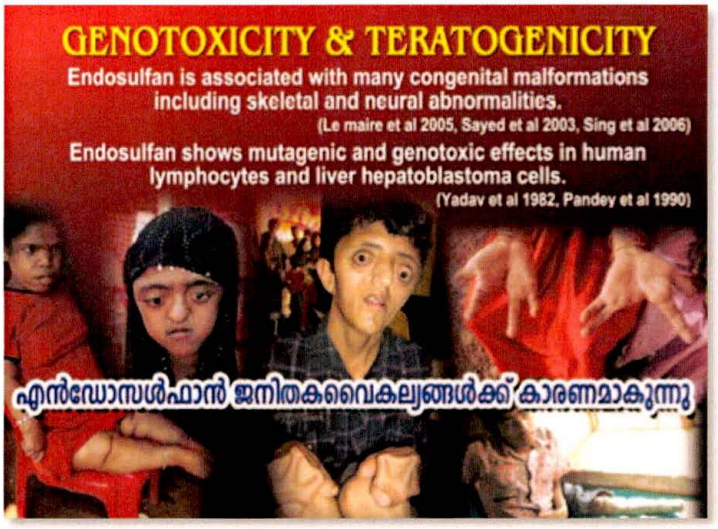


Figure 3: Pictures in the Government of Kerala report

source:Endsulfan: the Kerala Story, http://www.cseindia.org/userfiles/endosulfan_kerala_story.pdf; 28.10.13; 02:00, (p. 37), also present in Dr. Asheel's sources

Endosulfan however is being more often described as a carcinogen, for example, the study by Antherieu et al in 2007 described endosulfan as a substance that generates oxygen radicals causing oxidative stress, resulting in the damage of cell structure. This means that endosulfan has mutagenic effects, causing DNA-strand breaks. It also was described to inhibit apoptosis, which is cell death, and this could contribute to the survival of mutant cells, increasing the risk of cancer. Cancer occurs when cells multiply in an uncontrolled manner. [23]

At low concentrations, endosulfan is said to inhibit the aromatase enzyme, which catalyses the conversion of androgen hormones to oestrogen (Andersen et al 2002). Many other potential cancer - provoking effects can be described, which usually means enabling the possibility of cell proliferation. (Laville et al 2006; Bradlow et al 2002; Rousseau et al 2002; Wozniak et al 2005). In addition to this, endosulfan also interferes with the mammary gland by affecting mRNA transcriptional activity (Je et al 2005). [23]

5. Effects on the Reproductive System

Endosulfan causes the decrease in male sexual cells (spermatozoa), by inducing their degeneration, their death or simply causing aspermatogenesis [24], which is the failure in a male to produce spermatozoa. (Daisenter et al 1999, ATDSR 2000, Sinha et al 2001)[25]

6. Teratogenicity and Genotoxicity

Endosulfan is teratogenic and mutagenic and can cause several types of genotoxic effects. Brain disorder and birth defects have been studied in laboratories and in human populations that have been exposed. It is linked to long-term neurological effects such as epilepsy, and may cause Parkinson's disease. [26]

Other problems linked to the central nervous system have been noted among children having faced exposure such as cerebral palsy, growth and/or mental retardation, epilepsy and skeletal abnormalities.*(See definition in Annex 2)* It is important to note that there is an increased rate of miscarriages among women, which again can indicate problems linked to the foetuses.Psychiatric problems have been noted, with an increase in suicidal tendencies, all within the population under the age of 25. [27]

C) Epidemiological Aspects

"Epidemiology is the study of the distribution and determinants of health-related states or events (including disease), and the application of this study to the control of diseases and other health problems." [28]

The largest amount of studies linking pesticides and breast cancer have been carried out in relation to organochlorine pesticides. This class of pesticides is easily measured in adipose tissue, serum and breast milk. Many can also be described as endocrine disruptors influencing oestrogen levels, and carcinogens, this has been shown in the laboratory. However, it is to be noted that while some epidemiological studies show the association to endocrine disruption and cancer and others have not. [29]

One of the problems with epidemiological studies is that they fail to see the link of causality between the pesticides and the effects, as it was observed for many years with DDT. The main issue concerns the level of residues that decreases after the ban of a certain pesticide and the determination of an exposure, which will strongly dependent on each situation and are measured with difficulty. In the

case of endosulfan, more than 1500 publications discuss the dangers that this substance can have on humans and the environment. These have been and presented by Dr. M. Asheel, who kindly gave me the presentation that helped convince the Stockholm Convention and the Supreme Court of India. I will base myself on this presentation for the following explanations. [30]*(See Dr. Asheel's interview, Annex 3)*

The two important questions concerning endosulfan use are:

- Is there enough scientific evidence on health effects of endosulfan?
- How strong is the evidence?

There are two approaches when evaluating the toxicity of an agent:

1. Observational studies to investigate the contact between the agents and the chemical, and it can be done either prospectively or retrospectively.
2. Experimental studies under controlled conditions on animals, living tissue or cells. The results can then be extrapolated to human and animal populations.

It is possible to establish "causality", which is the relationship between two events (the cause and the effects), where the second effect is the consequence of the first. This requires rational deductive analysis of scientific evidence.
The principles involve six points:

- **Temporality**
- **Association**
- **Strength of association**
- **Consistency of association**
- **Dose response**
- **Biological Plausibility**

All of these points have been fulfilled with regard to endosulfan. *(See Chapter VII. Endosulfan in India, Section D) Evidence: Proof of endosulfan contamination in Kasargod)*

VI. The Story of Endosulfan

A) Global use of endosulfan

Since its development in the 1950s, endosulfan has been used an agricultural insecticide. In the last decade, different sources around the world such as health-related websites, government agencies or companies have given technical information about endosulfan, concerning its (eco)toxicity, environmental fate, residue in foodstuffs and feedstuff or environmental concentrations, particularly in this last decade. [31]

Endosulfan is an insecticide mainly used to control chewing, sucking and boring insects, including the tea mosquitoe and was used on a very wide range of crops *(See Figure D: Table of pests targeted by endosulfan, Annex 1)*. Certain ornamental and forest trees were sprayed, and this substance is also known to preserve industrial and domestic wood.

The use of endosulfan was already banned by 2010 in least 60 countries including Switzerland. Countries that were using endosulfan in 2010, included the USA and India. [32]

Today, endosulfan is being phased out globally.

B) Endosulfan production

Endosulfan was developed in the early 1950s. The production is fairly simple, involving three steps, and by 1984 10,000 tonnes per year was being produced. In the following decades, the production further expanded to 18,000 - 20,000 tonnes per year. In China, 4,602 tons in 2006, 5,003 tons in 2007, and 5,177 tons in 2008 were produced. Germany stopped producing its almost 4,000 tons per year in 2007 but continued exporting until the end of 2010 (UNEP/POPS/POPRC.5/10/Add.2) [31]. Other producers were thought to be located in Israel, Brazil and the Republic of Korea. (UNEP/POPS/POPRC.5/10/Add.2) [31]. This means that annual production amounted to 18,000 - 20,000 tons worldwide in 2010, with approximately 10,000 being produced in India, 5,000 tonnes in China and 3,000 to 5,000 tons in Israel, Brazil and the Republic of Korea. [32]

Picture 4: Farmer in the State of Orissa, North India, spraying endosulfan before the 2011 ban

source: http://www.orissadiary.com/CurrentNews.asp?id=14778; 4.11.13; 23:36

Historically, the production of endosulfan in Europe came up to 10,000 to 50,000 tonnes per year,. However, it was stopped in the Czech Republic, Germany, the Netherlands and in Italy in

2006/2007, According to the United Nations Economic Commission for Europe, endosulfan production was stopped in the USA by 1980s. Columbia was an endosulfan producer until 2001, when production was banned. [32] *(See Figures E, F, G and H- Showing maps of endosulfan usage in the world prior to the global phasing out Annexe I)*

VII. Endosulfan in India

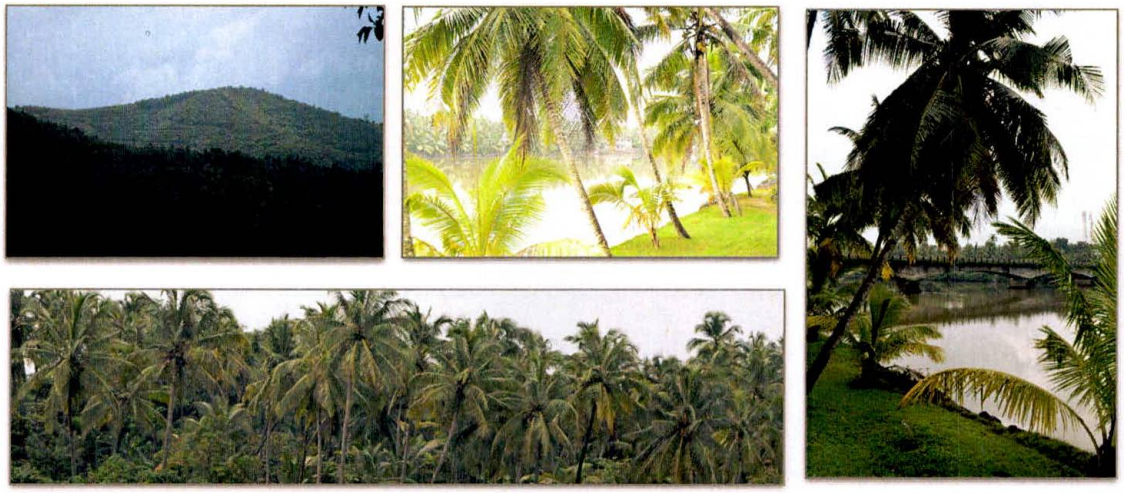
India was the world's largest producer (9,900 tonnes per year) and the leading exporter (4,104 tonnes in 2007-08 to 31 countries), according to the United Nations Environment Programme. The production of endosulfan was banned in India in May 2011, but until then it accounted for 50% -60% of global production. [31]

A) Introduction to Kasargod District, Kerala

The Kasargod district is situated on the northern tip of Kerala, between theWestern Ghats Mountain range and the Arabian Sea, with 14 rivers flowing in this one district. It took me twelve hours to travel from the capital city of Kerala, Thiruvanathapuram, to Kasargod. The countryside is magnificent, with a thousand shades of green reflected in the many lagoons and estuaries that characterise its unique ecosystem. Professors Rahman and Valsan explained the history, geography and socio-economic setting of this region, and thanks to them I could access such important information. *(See full interview Annex 3)*

There is a vast diversity among the people: seven different languages are spoken in this region, which creates linguistic barriers. There is also the coexistence of different religions: Hinduism, Islam and Christianity. Unfortunately, unlike in the rest of Kerala, inter-religious conflicts have occurred, and tensions still do exist. In Kasargod, our local driver explained the problems that had arisen these past few years related to emigration, increased religious fundamentalism and political tensions. Along with this, there has also been the environmental havoc caused by endosulfan Nevertheless, in this tropical paradise, there are few apparent obvious signs of it.

Over the centuries, the region has been conquered many times, because of its fertile lands: the eight historic forts prove this, having been built by successive kingdoms that ruled at different periods. Nowadays, Kasargod is highly political, with many political parties and trade unions. Another interesting fact is the existence of a prominent matriarchal Nair community in this region,where women play a prominent role in the community.[33] In the wider Kerala context, women have been encouraged to be educated, and therefore to express their voices and opinions along with men.



Pictures 5, 6, 7 and 8: Pictures of Kasargod, Kerala
by Grace Kurian

B) Endosulfan use in Kasargod

The Green Revolution in India took place in the 1970s. It was a policy that was adopted because of prospects of famine and mass starvation following a post-war population boom. It consisted in the use of high-yielding seeds, irrigation and pesticides. [34] In the context of the Green Revolution in India, the use of pesticides was initiated and endosulfan was introduced in Kerala. Cashew is a crop that was brought by the Portuguese in the 15th century, to avoid soil erosion. The cashew nut is expensive. In 1976, the Kerala Plantation Corporation first started using endosulfan in cashew plantations, as part of a new monoculture. They decided to invest in this cash crop for exports, and started using endosulfan because of the tea mosquito, which was claimed to infest the fruit of the cashew tree. *(See full interview of Prof. Rahman and Prof. Valsan Annex 3)*

In 1977, it was decided that the chemical would be sprayed by helicopter over the plantations. Since the region is so politically active, there were mild protests because of the few jobs that were lost. But nothing significant was done. What followed was the widespread use of the pesticide. In 1978, there was a fist article published by Shree Padre, a farmer and journalist from Kerala, called "Life is cheaper than cashew", which reported the birth of a deformed calf. This article is very important in terms of chronology, for it is one of the earliest complaints against endosulfan, and was mentioned by many of the stakeholders including Jayakmar C, Prof Rahman and Prof Valsan. *(See the respective interviews in Annex 3).*

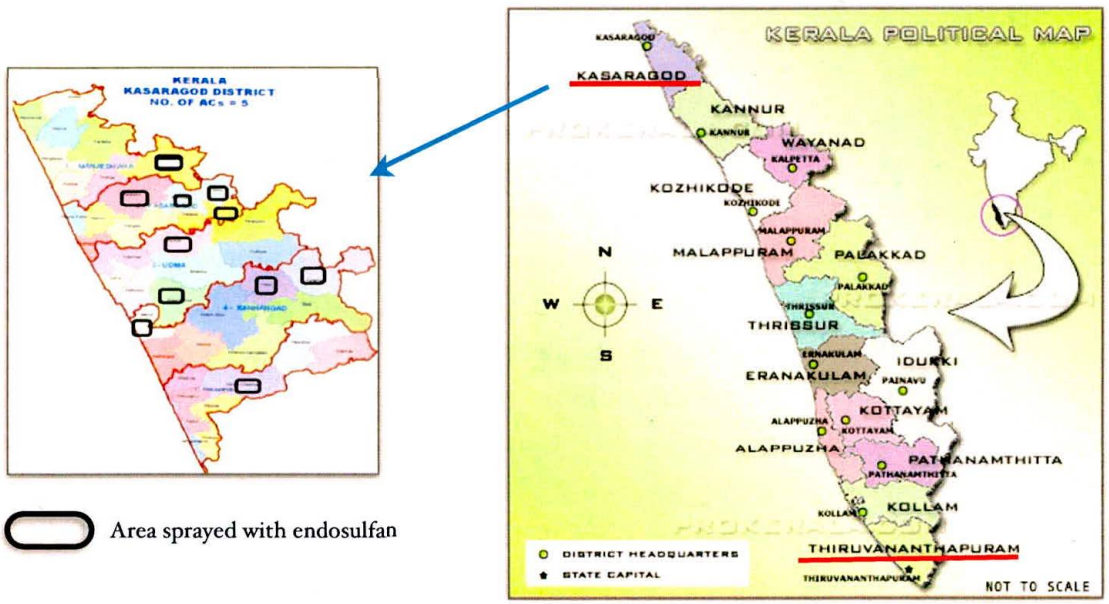
The region was indeed facing strange changes, and there were complaints from farmers. This, however, was dismissed as allegations, and nothing was done about it. In 1997, Dr. Mohan Kumar wrote about the situation in Kasargod where many of the families living around a particular stream were born

with handicaps.However, some medical committees made investigations, for example in 1992 the Dr. Banerji Committee recommended severe restrictions which were not respected, not until 2001.

"Harvesting is done between March and April, and there are three to four people who harvest a kilogram of cashew, they have to eat during the season and this despite the water contamination or pesticide sprays." said Dr. Mohankumar. The precautions also stated that the area that had been sprayed could not be entered for at least 15 days. It was supposed to be done 5m above the trees, but it used to be done almost 70m above the trees, as mentioned by Dr. Mohankumar, Prof. Rahman and Prof. Valsan.

In 1998, Sreemati (title that shows respect) Leelakumari, an agricultural expert, took the case of endosulfan use to the municipal court, asking for relief. With the help of the Non Governmental Organisation THANAL. In 2000, a person from Pesticide Action Network Asia-Pacific, came to investigate on the problem and concluded that it was indeed the endosulfan that was causing the problems. It was then described how endosulfan isomers α- and β-endosulfan breaks down into endosulfan sulphate when heated, which is a substance which is persistent in soil, water, air and fat. It's half life is around 800 days. (recounted to me by Jayakumar C . from THANAL *(See full interview Annex 3)*

Smti Leelakumari won the case to ban endosulfan at a state level by 2001, exactly a quarter of a century after its first use. *(See Chapter IX. Legislation of endosulfan, Section C) Endosulfan Ban)* Many court interventions took place in the years that followed concerning the relief for the victims. In 2005, the District Endosulfan Remediation and Relief Cell was formed. A year later, the State of Kerala started relief work. Dr Mohankumar recounted the building of "bud-schools", that provide physiotherapy and teach disabled children with physical and mental handicaps.Eleven such schools were built. *(See Dr Mohankumar's interview Annex 3)*



Figures 4 and 5: Maps of India, Kerala and Kasergod, with the areas sprayed with endosulfan

source: http://files.prokerala.com/kerala/maps/kerala-location-map.jpg; 20:10:13; 01:56; Dr Asheel's presentation

C) The Stakeholders' Perspectives

(For the full interviews see Annex 3)

"Kerala is the only place where you can walk into a tea shop and talk about endosulfan." Those were the opening words of Dr. M. Asheel as he spoke at the Stockholm Convention in Geneva in April 2011.

1.Government

The company responsible for the aerial spraying in cashew plantations was the Kerala Plantation Corporation, a government-owned company. This may appear scandalous, but the truth is that they did not follow safety regulations like the appropriate height from which the spraying should be done, or the time during which human activity in the sprayed areas had to be limited. Farmers, doctors and even the government workers who mixed the pesticides have reiterated this fact. The huge over-exposure of the population is probably the result of greed for profit at the expense of poor and powerless small farmers in the region and workers in the plantations. After many years the government has decided to support the people who suffered because of the endosulfan spraying through comprehensive welfare schemes.. Furthermore government schools have been started for the mentally retarded children.

2.Non-Governmental Organisation

Tuesday 9th July 2013

Jayakumar C., zoologist, one of the founders of THANAL (Conservation, Action and Information Network), activist

Hopeful to get more information in India, my first interview was in Thiruvanantapuram, the capital city of the state of Kerala. Jayakumar welcomed me and gave me a detailed summary on the events concerning endosulfan use, its ban and THANAL's involvement in the campaign to ban the pesticide. Initially assisting Smti Leelakumari to prove that endosulfan was the root cause of the diseases that were striking Kasargod, THANAL went on to participate in the Stockholm Conference for Persistent Organic Pollutants supporting the global ban of endosulfan.

Jayakumar also introduced me to some of the key actors namely Smti Leelakumari, Dr Mohankumar, and Dr M. Asheel. During the interview, an interesting point was raised on reason why the substance had affected Kasargod so much. In the 1960s there had been land reforms in Kerala, when a communist party came officially to power through a democratic election. Though they did not remain

in power continuously, it was enough for the feudal system in Kerala to be completely changed. Each person cultivated his or her own land. This meant that people lived on there land, interspersed among the different plantation grounds. "The farmers themselves used to initially stand on the border of the plots, to show where the helicopters should spray the chemical" explained Jayakumar about the dreadful use of pesticides. Moreover, due to the fertility of the land, people have been attracted to Kerala, making it one of the most densely populated regions in India, again increasing human exposure to the pesticide.

The international concern was then expressed, as endosulfan had a socio-economic impact. Furthermore, a global ban would stop the bio-accumulative and the long-range transport of the molecule. This phenomenon is called the grasshopper effect, and it was shockingly explained to me that endosulfan could be carried through the air, so much so that breast milk samples in Denmark and Finland had clear traces of endosulfan.

An intriguing criticism was made by Jayakumar: it seems that healthcare that is administered in the world is 93% palliative, and 7% preventive. In medical schools, for example, very little is taught about such extensive toxicological aspects.

Another saddening fact that was mentioned during the interview was that Israel had published a paper back in 1979, which said that endosulfan could cause brain damage. This is a few years after endosulfan was introduced in Kerala. Around 9000 to 10000 people suffered direct health problems in Kasargod according to Jayakumar, who worked on the field to prove the link between the pesticide and the effects. Thankfully, after the ban of pesticides in India, many of the alternatives that have been suggested are biological, which is a milestone for agroecology.

Jayakumar and his wife Usha are both founders of THANAL, and they have dedicated their lives to the safeguard of the environment.

3. Agriculturalists

Saturday 13th July 2013

Sreemati Leelakumariamma, agricultural specialist

"What has been done to the land and to the people causes me much pain" said Agricultural officer Sreemati Leelakumari who worked for the Plantation Corporation of Kerala for many years, and distributed endosulfan as part of her job. "I would tell the farmers to be very careful with it, as a pesticide was actually poison (vesham), not to be considered as medicine (marunne)." she says of the toxic substance. Even worse were the aerial sprays. After buying the land on which her house was built, close to cashew crops in Kasargod, her husband, children and she moved into a barren land. " The aerial spraying would take place three times a year and the helicopters would fly over the entire countryside "There were no wild boars, no frogs and no fish in the river." A year went by and she noticed that her son was

getting skin problems, and that he was having trouble breathing. She also realised that the local people were facing increasing health problems, as well as fewer fish to eat. As a mother, a citizen and a human being, she felt responsible; she had studied about pesticides in university and knew the health problems had something to do with them. She filed a case in 1997, literally taking the company that employed her to court. "Everyone was against it, the people, my husband (who also worked for KPC) and the policemen." She triggered a social movement that would change the international classification of endosulfan. Thanks to her, endosulfan was first banned in Kerala in 2001, and with the help of THANAL, an NGO that fought for the ban till the end, an international ban was issued in October 2012 and in India this was valid from May 2013 onwards.

Sreemati Leelakumari received many awards and books have been written describing her key role.

4. Doctors

Saturday 13th July 2013

Dr. Mohamed Asheel, MBBS, MPH, MDP Asst. Nodal Officer Rehabilitation of Endosulfan Victims Govt. of Kerala

Dr Asheel is a young doctor who recently completed his Master's Degree in Public Health. He literally risked his life whilst campaigning for the ban of endosulfan, standing up against pesticide companies and going to court as a doctor backed only by scientific evidence.

At first he looked into the endosulfan issue following the request of a university professor, and realised, it was not just another story hyped up by the media, but had in reality had devastating consequences. Having researched the topic of pesticides, he found out about the Stockholm Convention on Persistent Organic Pollutants, and realised that the only NGO participating in it was from Kerala. He then contacted Jayakumar at THANAL and then present the medical evidence concerning the hazards of endosulfan during the conference held in Geneva.

The politics involved in the conference were baffling, as the government of India, the world's largest producer of endosulfan, opposed the ban, but the State of Kerala was for the ban. *(See Chapter VIII "Legislation Section", under point c: "Endosulfan Ban").*

What really interested me were all the complications linked to influence, power and the answer to the simple question of who made a decision. In the end it was pure and simple politics.

The scientific facts were clear, the use of endosulfan was dangerous, and endosulfan levels in people were extremely high. He cited many shocking facts in his presentation, which was truly compelling and well put together.

In the end, the Stockholm convention listed endosulfan as a chemical to be phased out, but India settled by saying that endosulfan would only be banned in Kerala and Karnataka, the regions where there had been problems. The response was immediate, and the Democratic Youth Federation of India, which is a youth communist party in Kerala went to the Supreme Court of India *(See Chapter VIII "Le-*

gislation Section", under point c: "Endosulfan Ban").

Dr. Asheel made a very important point when I asked how come it had taken so long for the world to recognise the problems linked to endosulfan. He said that "science is falsifiable", and therefore that it is possible to change facts, in order to push for decisions which can harm the population.

Dr Asheel is currently working on the rehabilitation of endosulfan victims and guiding in the compilation of victims who will benefit from state support.

Sunday 14th July 2013

Dr. Mohankumar Y. S., MBBS, worked in Kasargod for more than 30 years

We drove up to the hilly regions of Kasergod Kerala, and met the doctor who had kept very precise records of the ailments of patients in the region being affected by endosulfan.

Dr Mohankumar recounted that he had started working here in 1982. There were three clinics in this rural region bordering Karnataka, and the doctor was not expecting to see many difficult cases in the region, since the place was pristine and people were healthy."There was practically no anemia or malnutrition, which was great and indicated an ideal place, this place is actually called Swarga (heaven)" he said, indicating the road-sign.

During the initial years, the doctor noticed many strange diseases which were both psychiatric and physical, and each house started having 3 to 4 sick people. At that point he wrote to senior doctors in the neighbouring towns but no serious investigation was done from the State. Slowly, more effects could be seen within the population such as more epilepsy, miscarriage and other abnormalities, in children and adults. The helicopters flew two times a year, and slowly *"Swarga (heaven) became a living hell."* as Dr. Mohankumar put it. The article he wrote in 1997 about the situation was published in the Kerala Medical journal, but proof of the correlation between endosulfan and the diseases were difficult to prove. There were only two places in India where there had been the use of aerial spraying: one was Kerala, the other Karnataka (the neighbouring state). Similar abnormalities were recorded in Daramsala, Karnataka, although there were fewer reactions than in Kerala.

The ban in Kerala really changed the situation. There has been a noticeable decline in such cases according to Dr. Mohankumar. The effects significantly decreased since 2001: there are fewer miscarriages and abnormalities. In the last five years not even birth abnormality has come to Dr Mohankumar. "But society will have to take care of the victims, and wait for another two generations to be really rid of genetic anomalies." he explained.

Dr. Mohankumar took part in a national television debate on social issues directed by Aamir Khan, a veteran film director, in a nationally televised programme called Satyamev Jayate, exposing the endosulfan scandal and testifying the reduction of miscarriages after the stop of the areal sprays. He was later sued and harassed by the pesticide companies, but the people of the region defended him. ***His observations provided scientific evidence for the toxicity caused by endosulfan***

Tuesday 30th July 2013

Dr Pradhyumna, MBBS, MSc Public Heath, responsible of research and training interests in Environmental Health and Epidemiology, SOCHARA, Bangalore, India

A few weeks after my visit to Kasargod, I went to Bangalore, one of the biggest cities in South India. There my uncle took me to the (Society for Community Health Awareness Research and Action) SOCHARA office, where I met a doctor who is also very interested in the environment. I interviewed him mainly about the state of environmental health in India. *"Environmental Health as a subject is evolving on a global scale, the most basic definition of it is actually: How does the environment impact human health, and specifically how do changes in the physical, chemical and biological characteristics of the environment impact human health."* he pointed out. He continued by saying that in India the environment is not taken seriously enough. More emphasis is given to the industry. Even farmers, who know that pesticides are bad for health, use them. Hence they always cultivate some crops without pesticides and keep it for the family. Political will is actually crucial when it comes to such issues, and politics is linked to economics. In our world, it seems difficult to change the fact that the poor become poorer and the rich become richer. Many international companies come to India, because the rules are easier to get around. After this conversation, it was rather difficult to ignore the blatant injustice that certain people in India are facing.

But here again he mentioned the Kasargod case as a unique situation where one pesticide was used, and this enabled people to identify it and prove the dangers of the environmental pollutant, thanks to temporality- the fact that after the ban, the situation improved.

5. Social activists

Saturday 13th July 2013

Professor M. A. Rahman, documentary producer, writer, retired Professor and social activist
Professor G. B. Valsan,writer, retired Professor and social activist

During this interview I met retired professors, or rather professors who had merely changed their profession. They had actively participated in the fight to ban endosulfan, and most recently written a book, and Prof Rahman made a film documentary about the issue. They also had set up an organization to help the victims. Thanks to them, I really understood the socio-political and geographical aspects of the problem. *(See Chapter V. Endosulfan in India, Section A and B))*

The language barriers and ethnic tensions were described, along with the a historic overview of the story. Since the cashew plantation was a monoculture, nitrogen fixing would not be renewed, which was a long-term problem. And as the first environmental movement in India, the Silent Valley, took off, Kasargod was peaceful, or so it seemed. In reality, the biodiversity was highly affected and was being destroyed. "After the Green Revolution food went from being organic to exactly the opposite.", they explained that the argument that is repeatedly used is that a higher yield that could be collected. Some say that this is not true and that absolutely no higher yield can be noted.

The misuse of endosulfan was also underlined, like the fact that the highly wet topography of the area was not taken into account. The regulations were not followed and the local population suffered; up in the villages, people went on with their daily lives, eating contaminated livestock, and drinking the water. However those who took the decisions stayed away from the region.

They highlighted the importance of Smti Leelakumari who initiated the movement, and Dr Mohan Kumar who helped by writing detailed observations of the victims. The Centre of Science and Environment of India (CSE) works on a national level, but they took a long time to see the problem. "Certain people still maintain that there is no problem." But now it is undeniable, as the NIOH and the government of Kerala has admitted it.

An organisation named "ENVISAGE" (Endosulfan Victims Support Group) was set up two years back by activists, including the interviewees. Masters Valsan and Rahman have written extensively about the subject in Malayalam magazines. Six groups in the Arabian Gulf are currently active and many people help this charity organisation. The aim is to help the victims by setting up palliative care facilities, for example.

6. Industry

The pesticide industry made a huge loss when endosulfan was internationally phased out because its industry was worth billions. I was unable to contact any of the members of the industry. However, the interviews gave a lot of insight into the power of the industry and the role it played during the 25 years of spraying.

For example many, of the interviewees mentioned the pressure that the industry exerted on the local politicians and the influence they had on the local communities when it came to the use of endosulfan. This can be illustrated by a scene of the documentary film by Prof. Rahman, which shows reporters threatened by farmers when they were asking questions about victims.

Furthermore, the fact that many of the government agencies hadn't looked actively into the endosulfan issue seems to coincide in a country which was the largest producer of endosulfan.


ഒരു ചിത്രശലഭത്തെ
എങ്ങനെ വരയ്ക്കാം?

Figure 5: Page of a Malayalam magazine article with illustration, about the endosulfan issue in Kasergod.

Source: Prof. G. B. Valsan

D) Evidence: Proof of endosulfan contamination in Kasargod

Concerning the story of endosulfan use in Kasargod in India, the elements of causality were evident: temporality and association were achieved thanks to the fact that Dr. Mohan Kumar had observed the symptoms of many of the inhabitants of the region where endosulfan was being sprayed, and documented them. Then following the ban on endosulfan in Kerala in 2001, there was a reduction of the effects, and temporality was confirmed.

A for association, people working in the fields and people living in the regions were affected, and not the people living in neighbouring regions where endosulfan was being sprayed.

The risk here was aggregate (linked to one pesticide), not cumulative (linked to the use of a group of chemicals that share a common mechanism, like organochlorines), hence it was easier to determine the causal association between endosulfan and these adverse effects, than coining the endosulfan adverse effects among the effects of a cocktail of pesticides. Moreover, more than 1500 scientific publications were written on the effects of endosulfan including one by the National Institute of Occupational Health in India (NIOH) [35] which concluded that there was a significantly higher prevalence of neurobehavioral disorders and congenital malformations in female subjects, and abnormalities linked to the male reproductive system, in the endosulfan-exposed group than in a reference group from the neighbouring region. The consistency and strength of association were determined thanks to the number of papers that related similar happenings in other endosulfan-exposed regions.

Picture 9: Teratogenic and Mutagenic effects observed in Kasargod, Kerala, after 25 years of areal spraying

source:http://socialism.in/wp-content/uploads/2011/06/endocolash1.jpg; 28.10.11;

The biological plausibility and dose response relationship were also very clear, since endosulfan blocks the receptor for the GABA neurotransmitter, which makes neurological health hazards highly likely.

		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

Figure 6: Statistics on endosulfan patients from the Government of Kerala

source:Endsulfan: the Kerala Story, http://www.cseindia.org/user-files/endosulfan_kerala_story.pdf; 28.10.13; 02:00, (p. 37)

The dose response was observed in the laboratory, but also in the Kasargod case, since a government committee during Chief Minister Achuthanandan's time said that the Kerala Plantation Corporation's supervision of the spraying did not respect the safety precautions. Although this supposedly high dose induced many catastrophic effects, low doses have also been described to disrupt cerebral cortical functions. [36] A report was published by the Government of Kerala, acknowledging the negative impact of endosulfan and demanding a global ban. It gives statistical evidence on the 4273 victims living in Kasargod. [37]

The truth is that many of these reports are very recent and can only be found in publications and not in textbooks.

VIII. The Economics of pesticide use and endosulfan

A) Need for effective pesticides

Pesticides are considered necessary for agriculture, as its use is claimed to prevent the loss of up to one third of agricultural produce from pests and hence contributes to providing nourishment for the population. It is also vital for Public Health as pesticides form a key tool for countering vector-born diseases such as malaria that is transmitted through mosquitoes. Although it is poisonous because of its aim to destroy pests, it can be viewed as "environmental medicine", as it can correct insect imbalances.[38]

Most lobbyists who promote the Pesticide industry use this as evidence, which is nevertheless debatable, and will be discussed in the Chapter on solutions.

B) Influence of the global pesticide industry

A current study has shown that the pesticide industry is valued at 49 billion US dollars and it is estimated that it will grow to 59 billion US dollars by 2016 USD. [39] In comparison, the budget spent on defence in India is of 46,1 billion USD in 2013, 8th biggest military spender, the biggest being the United States of America with 682 billion spent on defence, followed by China which spends 166 billion USD. [40] (Switzerland spends much less in comparison, about 4.8 billion). The demand in developing countries will further rise, and countries such as Brazil, Argentina and China are expected to buy large quantities of pesticides for their economies.[39]

C) Environmental Risks and Costs

It is it is difficult to both assess and manage environmental risk, as the causes and effects are often difficult to determine. In Kasargod, the first complaint in 1979 regarding pesticide contamination was seen as an allegation. The effects were initially not obvious, however they became more evident when the prevalence of diseased children increased.

What happened in Kasargod is not unusual because pesticide poisoning generally occurs within a long chain of events. To begin with, it is applied to an agricultural field, and the pesticide may be evenly or unevenly spread. This may or may not be present in the harvested foods and may or may not be ingested by people. The final health hazard will only be perceptible in certain people, depending on their age, sex, the levels of ingestion of pesticides or other characteristics of the consumer. [41]

In addition to this uncertainty comes the cost. In India, the cost of replacing endosulfan with chemical alternatives has been estimated from 0 to 9.63 million US dollars *(See Figure I on Estimated costs for replacing endosulfan, Annex 1)*

Another challenge with environmental risk is the time span between the initial pollution and the visible signs of adverse effects. "It may take years or even decades for a hazard to turn into a risk."[36] This happened in the case of Kasargod as well.

The next most important question is: Whose assessment of the risk should be taken into account? While judging environmental risk, two parties are concerned: the expert and the lay person.[36] In the case of endosulfan, the experts were not necessarily part of the government or the industry, but were closely linked with the people working in the field, hence the evidence was credible and stood scrutiny.

D) Effect of self harm using pesticide in the developing world

Suicide remains one of the most common causes of mortality in the younger populations in India and in many other developing countries. Pesticides are a common means by which people commit suicide. It is often accessible to the public as it is available in high concentrations, and is cheap because of public subsidy. In case of a failed suicide attempt, it often results in various long deleterious effects. This phenomenon has mainly been observed in Asia, Africa and Latin America. This is negative for the economy, but also for the health and well being of the population and constitutes a societal cost. Thus opting for more organic agriculture, that does not promote the use of chemicals, is an important task for these countries. [42]

IX. The Legislation linked to endosulfan and pesticide use

A) Standard laws

Most countries respond similarly to pollution: they use emission charges as an economic incentive to reduce pollution. International agreements are made when a problem concerns more than one country, as it is the case with Persistent Organic Pollutants (POPs). [41]

The problem with environmental legislation is that it is difficult to enforce. Nevertheless, the importance of having regulation is not diminished, even if the execution is weak, for at least it is described that something is banned and there is then a legal basis on which one can complain.

B) International Environmental Law: Stockholm Convention

In International law a Convention or a treaty is a legal document which has to be accepted by a certain state and ratified in the state's national law to become valid. There are several steps towards the creation of a convention: first there is the adoption of a legal text, which then has to be signed and ratified by a certain number of countries for the law to become official. Once the law is ratified it has to be implemented in the national laws of the countries.[43]

The Stockholm Convention on Persistent Organic Pollutants (POPs) is a global treaty in International Law. It was adopted at a Conference of Plenipotentiaries on 22 May 2001 in Stockholm, Sweden. The Convention entered into force on 17 May 2004, on the ninetieth day after the date of de-

posit of the fiftieth instrument of ratification, acceptance, approval or accession, conditions stipulated by the Convention.[43]

The Stockholm Convention aims to protect human health and the environment from chemicals that remain intact for long periods, and become distributed geographically, accumulating in human tissue and wildlife. The chemicals are divided into three categories: Annexe A, B and C. Annexe A lists the pesticides to be eradicated, and endosulfan is one of them. [44]*(See Figure J: Liste of Persistent Organic Pollutants which are destined to be eliminated, Annex 1)*

The exposure to these 23 chemicals is deemed to lead to severe human and health effects. The countries which have ratified the Stockholm Convention are on the map in Annex 1. All countries in the world except the United States of America, Italy, Malaysia, Turkmenistan, Uzbekistan, Irak and South Sudan have ratified the Convention. [45] *(See Figure K the Map of countries that are part of the Stockholm Convention, Annex 1)*

C) Endosulfan Ban

The endosulfan ban was formally decided following the 2011 Stockholm Convention's conference that was held in Geneva. The worldwide phasing out was adopted in October 2012.

The process had taken a long time (around 32 year), starting from Shree Padre's article in 1979 and Sreemati Leelakumari's court case almost twenty years later, to the involvement of activists, politicians, doctors, scientists, the media, THANAL, and finally the Reviewing Committee of the Stockholm Convention. In Kerala the ban was effective, the Munsiff court (municipal) guaranteed a ban in 2001, which was later executed. As explained by Jayakumar C. from THANAL, the main argument of the lawyers when the case went to court in Kerala is the article 21 of the Indian constitution, which guarantees a right to live. Finally, the court case ruled in their favour, and aerial spraying was stopped in 2003, since they deemed that "human life is more important, than the possible monetary losses", whether endosulfan was a POP (Persistent Organic Pollutant) or not.

Jayakumar C. then explained what the process was like for the global ban, during the convention itself. In 2007, endosulfan was nominated by the European Union as a chemical which was to be enlisted in the Annex A of the Stockholm Convention. The Review Committee was to meet in Geneva. In 2008 the application was given, and by 2009 the chemical was meant to be enlisted in Annex A, since it had a socio-economic impact. India filed an objection, whereas Switzerland filed support. In 2010, there was a Ban Endosulfan Campaign in India, and during the 5th Stockholm Convention meeting, (24th-29th April 2011) the situation changed. China and Israel, two countries which were previously favourable to the use of endosulfan changed their mind. Jayakumar and Dr Asheel were also present during the convention, and they opened their presentation by saying that there was a hunger strike in Kerala to support the ban on endosulfan. Dr Acheel explained during his interview, that the then ruling chief minister of Kerala V. S. Achuthanandan, supported the campaign to ban endosulfan. *(See Annex4 4)*

While the Stockholm Convention Conference was going on the social protest, and the hunger strike in Kerala helped convey the seriousness of the issue to the world.

There was a mix of political interests, the industry's pressures and social injustice. And after much talk and negotiations, the Ban Endosulfan campaign was a success story; a global phasing out was decided in 2011, but India was not inclined to ban in all its regions.

The Democratic Youth Federation of India (DYFI), a socialist political association, went to the supreme court of India, demanding that endosulfan be banned all over India, since the substance was being globally phased out. Dr. M. Asheel, whom I interviewed, was the doctor presenting the health hazards for the DYFI, and he explained what happened in court. Evidence was presented by three parties at the Supreme court; the government which said it was not sure of the effects, the industry, with nine doctors testifying and the DYFI who had a lawyer and a doctor. It ended with each party talking about what it had to lose: the government would lose around 811 million USD , the industry around 1.6 billion USD, and for the DYFI, "lives"would be lost. The main argument of the DYFI was that the Indian Constitution's 21st article guarantees to all citizens the "right to live". Based on this, the Supreme Court decided in favour of a national ban of endosulfan on 13th May 2011. Exports of existing stocks were permitted, until the expiry date of the pesticide, which would be two years after that date. So officially in India, from the 13th of May 2013, no more endosulfan could be produced, sold, used, or exported. [46]

During my interviews, it seemed clear that endosulfan was no longer produced on Kerala. But to extend that certainty to the rest of India and the rest of the world would be difficult. I is, however, safe to say that any present or future use would be clearly considered illegal.

X. Limitations of the research

In this research I have used the information that best reflected the events. I interviewed many of the key actors in the endosulfan ban campaign, and have used official websites and well-known reference books. However, it is has been difficult to verify the accuracy of all statements and comments.
It has also been difficult to obtain information from pro-endosulfan groups now since endosulfan is no longer produced or used. However other chemicals still have strong supporters.

A) Misinformation linked to the endosulfan issue and pesticides

One interesting aspect of the endosulfan use in Kasargod is that it was extremely difficult to get accurate information concerning this subject.

B) Dichotomous views

On the internet, there were two distinct camps when it came to endosulfan:

- Some websites talked about the attributes of endosulfan that made it less persistent than many other pesticides , and the fact that the media was hyping the whole issue, so that the new pesticides will have to be bought from other countries. There were many writers on the web that defended the idea that western countries wanted India to buy their new pesticides: endosulfan having been made off patent recently and relatively easy to produce had encouraged India to produce this pesticides, which meant western companies were losing their markets.
- Other websites were clear on the horrors that endosulfan caused in the population and emphasised on genetic mutations which had happened by showing many shocking pictures
- Most websites clearly say that pesticides are necessary to humans, for an efficient way forward for agriculture, and for controlling diseases.

The truth however, is hard to distinguish, are pesticides really the only way forward, do all countries wanting to develop efficient agricultural ways have to use pesticides?

In India, there were also two types of responses:

- Some people, especially people who did gardening, or laymen were confident in the fact that endosulfan wasn't a persistent chemical, and that the whole issue that has been going on is a scam, a hyped up story among many others.
- Unlike the part of the population that is not really aware of the situation, many of the interviews I carried actually explained the reality to me, and the state of things. Many were the crucial actors in enabling the ban of endosulfan, and there knowledge and references were very useful.
- Serious toxicity of Endosulfan noted in the extreme example of aerial spraying in Kasargod need to be taken into account. However, If greed and irresponsible behaviour is controlled effectively, it is not sure if endosulfan can be used as a relatively safe agent ?

C) Lack of interviews of the victims

All the information concerning the victims of endosulfan in Kasargod were given by the interviewed people (doctors, social workers etc).

I did not do any personal interview with the victims for ethical reasons, namely the fact that I would not be directly helping them in any way by writing about them. Furthermore the banning of endosulfan has been achieved, but the damage done to their lives is irreparable. I may also be insulting their integrity, which would mean showing disrespect.

XI. Solutions: Alternative methods

A) Alternatives for endosulfan

There are different types of alternatives for endosulfan use. (Endosulfan Risk Management Evaluation 2012). [47]

1. Chemical alternatives

Alternative chemicals, which have milder side-effects than endosulfan, can be used for specific crops or for a group of them. They can be more or less efficient depending on the region. The list of chemical alternatives include Deltamethrin, Imidacloprid, Insecticidal soap/Pyrethrin and Malathion to name a few. To answer the question of whether these alternatives are as efficient as endosulfan, a review of scientific literature (78 scientific papers) was carried out, and when 46 chemical alternatives were tested, in 152 cases, the alternatives were more efficient, in 18 equally efficient, 68 cases less efficient than endosulfan, 4 cases were inconclusive, 7 cases reported the development of resistance. Therefore, it is reasonable to say that there is a higher probability that chemical alternatives are more efficient than endosulfan. [48]

2. Semiochemicals

Semiochemicals[49] are substances that are used by organisms to send messages to each other, for example insects use them for mating. By using semiochemicals in agriculture, it would be possible to monitor populations of pests, and alter their behaviour. A semiochemical that has been suggested is pheromone, effective for example against pests in pear, apple, apricot or tomato crops. [48]

3. Bio-agriculture and biological systems

Organic farming is a form of agriculture that emphasises cultural knowledge and practices, and excludes synthetic pesticides. Some techniques are crop rotation, that enables the regeneration of the earth, green manure, like cattle excrements, mechanical cultivation to maintain soil productivity and pest control and biological pest-control systems. These includes the use of parasitic wasps, bacteria such as *Bacillus thuringiensi* for mustard, green gram and black gram crops, viruses such as *Helicover panarmigera* or nuclear polyhedrosis virus (NPV), or fungi like *fungus Beauvaria bassiana* used for Ragi (*Eleusine coracana*).

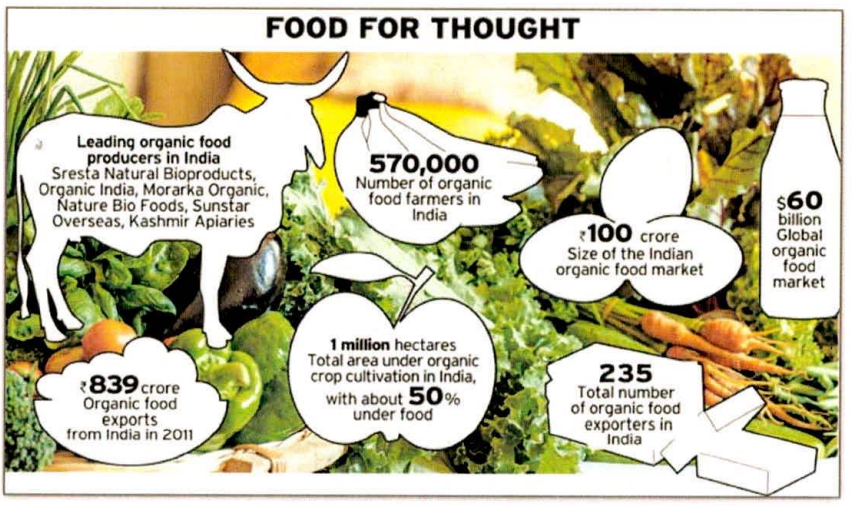
These examples have been recommended for use in India, according to the government. Such alternatives would be a pseudo-natural way of growing plants. [48] However one needs to note that the alternative systems mentioned are more difficult and often result in some increase in the cost of production. Society needs to pay for safer practices to avoid future suffering.

4. Agro-ecological practices such as IPM (Integrated Pesticide Management)

IPM is a system by which the crops grow in a healthy way, with the least possible disruption to the agro-ecosystems, which means the natural way in which the environment adapted to agriculture, and therefore encouraging natural pest control. The method stipulates that first come non-chemical alternatives, and then, if necessary, chemicals. They must target the pests as much as possible, with minimum effects on humans, non-targeted organisms and the environment, but if all other pest-controlling agents fail, then the use of pesticides is tolerated. [47]

5. Specific agricultural practices

Such practices are cultural ways in which pests can be controlled. These include techniques used in Organic Farming and IPM, but can be used in any type of farming. For example there is the selection of a certain variety of the crop, pest-free plants, selection of an appropriate time to plant, crop rotation, or planting of flowers like marigold or sunflower to attract certain beneficial insects. There is also the use of botanical insecticides etc.[47]



Note: 1 crore of Indian rupees (INR) is equal to 10 000 000 INR, which is approximately equal to 160 000 USD.

Figure 7: The Indian Organic market is growing, and people seem to be able to purchase better quality food as their income goes up.

source: http://businesstoday.intoday.in/story/organic-food-fast-catching-on-with-the-indian-consumer/1/191942.html; 05.11.13; 19:00

B) THE CHALLENGES TO ENVIRONMENTALLY FRIENDLY AGRICULTURE

Agriculture is both important for the food it produces and for the income of those producing the food. The 21st century's growing population needs adequate food supply and it is thought that conventional farming, which encourages pesticide use, can provide it. But in today's world, there are around one billion people suffering from chronic starvation and another one billion which is malnourished. Hence, the relevance of such farming is questionable. Thus increased productivity in the supply is not enough for curbing the problems related to food security, and this is a flaw in modern agriculture.Thus agriculture has become more of an industry, where profit, or wealth, is the prime driver of this industry.

There is a strong body of evidence that states that organic farming is better for the health of human beings and the environment. But only 0.9% of the world's agricultural land is organically farmed (37,2 million hectares)[50]. However, many studies have shown that organic farming is, in reality, overall more profitable for society. On the long term, the yield is higher in organic farms than in non-organic farms, and that the production cost is lower, as it is less dependent on the chemical industry.

However there are many factors that make it difficult to practice organic farming.

- The national or regional agricultural programmes support large-scale agriculture. This means that the government highly subsidises pesticides and conventional farming.
- There is more access to information on conventional farming, since extensive research has been conducted for pesticides or high-yielding grain. On the other hand, it is difficult to access, since organic research is still in its infancy. Knowledge on the subject is more difficult to obtain and ascertain.
- The comparative studies between organic and non-organic farming only consider the economic aspect. Other effects such as the cost of environmental, social and health impacts have not been broadly overlooked. These are extremely important, as they have delayed impact and indirectly affect farm economics.

In India, Jayakumar from THANAL explained that organic farming is more difficult precisely because of the government's subsides for pesticide use. Although the farmer may find it cheaper to use pesticides, it ultimately is more expensive.

"The world needs a paradigm shift in agricultural development: from a "green revolution" to an "ecological intensification" approach. This implies a rapid and significant shift from conventional monoculture-based and high-external-input-dependent insustrial production towards a mosaics of sustainable, regenrative production system that also considerably improve the productivity of small-scale farmers." [51].

Part of the "Key Message" of the Trade and Environment Review 2013 by the UNCTAD (United Nations Conference on Trade and Development):Wake Up Before It Is Too Late, Make agriculture truly sustainable now for food security in a changing climate.

Any change in the system requires political will, and unless people decide that it is necessary, it is difficult to enforce.

XII. Conclusion

A) General Conclusions

To conclude the issue, endosulfan is being phased out globally, and is therefore history.

a) Endosulfan is an organochlorine pesticide that was used widely at a global level.

b) It was applied by areal spraying in Kasargod against the tea mosquitoes that destroyed cashew crops, leading to severe environmental hazards, as well as toxicity in human beings.

c) In human beings, it has been shown to have affected the central nervous, endocrine, and reproductive systems, and has mutagenic, teratogenic and carcinogenic effects.

To answer the question on why it was used, we have several points:

a) It was used because production was fairly easy, cheap and it was deemed effective against the tea mosquito despite the fact that no proper study had been conducted on the necessity of using a pesticide.

b) The environmental risks and hazards were not properly evaluated.

c) The basic human rights of poor farmers and other local population was ignored

d) Health surveillance of emerging problems of the local population was not effective, the authorities took very long to notice and condemn the misuse of such a dangerous chemical.

It should be noted that since pesticides are subsidised from the government, the industry could have seen some benefit from the use of endosulfan.

a) Finally, after irresponsible spraying for a quarter of a century, Sreemati Leelakumari, a courageous citizen, took the matter into her hands and spurred a whole movement. Subsequent media coverage fairly complicated the story, causing misunderstanding among Indians themselves.

b) Health problems created by endosulfan were the main cause of controversy, because the toxicity of endosulfan appeared questionable for a very long time. We can see however that we have the tools to understand the problems and that it is possible to prove causality.

c) The ban was made possible thanks to a social campaign that mobilised Kerala and extended to the rest of India. Global initiatives and conventions played a crucial role in this. The international ban was the solid basis on which the final national ban was enforced in India, considering that this country is the largest producer of the chemical. These,however, are not binding laws, and have to be monitored and enforced by the government, so as to maintain the change they created.

d) In short, the reasons for using such a toxic pesticide for so long can probably be due to three reasons: inappropriate application of agricultural policy, irresponsibility and greed. Policy changed when people started indiscriminately using pesticides in the context of the Green Re-

volution. Irresponsibility was the reason that explains why no safety regulations were used for over twenty-five years. Greed came into play when there were monetary advantages in using endosulfan. I hope that such a disastrous chemical contamination will remain an isolated episode in History. Nevertheless, if pesticides continue to be used freely in agriculture as "medicine", how can we expect our food which is one of our most vital needs to be "safe"? Here comes the role of alternative agriculture, which despite its imperfections, is a viable option.

e) Change is possible, it is indeed slow and costly, but nevertheless possible, and this is what takes humanity forward.

f) Societal Awareness has to be increased regarding the fact that these is always a present cost to maintaining future health.

B) Personal Views

Much of the information I obtained during my research was completely new to me, and I discovered an area that was extremely compelling. Environmental Health has increasing importance in our modern era, and I feel that it was a privilege for me to study such a problem firsthand. The events in Kasargod really shocked me and Master Rahman's documentary was quite difficult for me to watch. The suffering is only too visible, and the fact that such atrocities took take place really shocks me. I discovered certain truths about human nature like greed and irresponsibility, but I also recognised and appreciated virtues such as courage and perseverance. On a more concrete level, understood the widespread usage of pesticides, which is both good to know but also quite scary. In parallel, I discovered the methods of alternative agriculture, that again completely baffled me in my perception of food production and gave me newfound hope in human innovation. I now wonder why these have not been further discussed in the wider society and do not constitute common knowledge, could it be because of the petro-chemical industries and their lobbying against organic food? Agriculture really need to have a paradigm shift.

The staggering complexity of the issue is what attracted me to this topic. I am quite glad I could make links between the economics, the politics, the legislation but also the humanitarian aspects of the endosulfan case in Kasargod. I think many of the realities in today's world require such a broad outlook on society and here again I found this to be a great learning experience.

I am also in awe of the many people I met and interviewed during my field visit. I especially admire Leelakumariamma, who is according to me a true example of bravery and an iconic figure in the ban in endosulfan. I think that if more women stood up against injustices in society, the world would certainly be a better place. I also was inspired by Dr. M. Asheel, whose dynamism and knowledge was quite impressive.

Finally I would like to add that I was happy to study a subject closely linked to my country of origin: India, and use my mother-tongue- Malayalam which is the main language used in the region.

XIII: Acknowledgments

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Annex 1: Figures, Tables and Maps

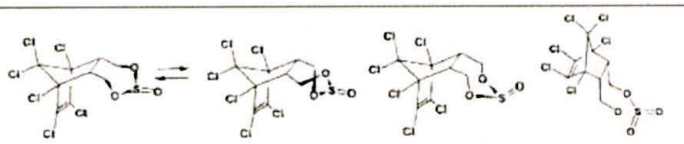
1.Figure A: List of pesticide functions and examples of their targets

[9]http://edis.ifas.ufl.edu/pdffiles/PI/PI08300.pdf, 18/03/2012, 06:47)
2.

Pesticide class	Primary target/action	Example(s)
Acaricide	Mites	Aldicarb, Bifenazate
Algaecide	Algae	Copper sulfate
Attractant	Attracts wide range of pests	Pheromones
Avicide	Birds	Avitrol (aminopyridine)
Bactericide	Bacteria	Copper complexes, streptomycin
Bait	Wide range of organisms	Anticoagulants
Biopesticide	Wide range of organisms	Bacillus thuringiensis
Defoliant	Removes plant foliage	Tribufos
Desiccant	Removes water	Boric acid
Fumigant	Wide range of organisms	Aluminum phosphide
Fungicide	Fungi	Azoxystrobin, chlorothalonil
Herbicide	Weeds	Atrazine, glyphosate, 2,4-D
Insect growth regulator	Insects	Diflubenzuron
Insecticide	Insects	Aldicarb, Carbaryl, imidacloprid
Molluscicides	Snails, slugs	Metaldehyde
Nematicide	Nematodes	Aldicarb, fenamiphos
Piscicide	Fish	Rotenone
Plant growth regulator	Regulates plant growth	Gibberellic acid, 2,4-D
Predacide	Mammal predators	Strychnine
Repellent	Vertebrates and invertebrates	DEET, methiocarb
Rodenticide	Rodents	Warfarin
Silvicide	Trees	Tebuthiuron
Termiticide	Kills termites	Fipronil

1. Figures B: Chemical Identity and Presentation of endosulfan

2. source: Stockholm Convention on Persistent Organic Pollutants; Persistent Organic Pollutants Review Committee Sixth meeting, Geneva, 11–15 October 2010, p.5

Molecular formula	$C_9H_6Cl_6O_3S$	$C_9H_6Cl_6O_4S$
Molecular mass	406.96 $g \cdot mol^{-1}$	422.96 $g \cdot mol^{-1}$
Structural formulas of the isomers and the main transformation product	 α-endosulfan	β-endosulfan endosulfan sulphate

1. Figures C: Chemical Identity and Presentation of endosulfan

2. source: Stockholm Convention on Persistent Organic Pollutants; Persistent Organic Pollutants Review Committee Sixth meeting, Geneva, 11–15 October 2010, p.5

Common name	Endosulfan	
IUPAC Chem. Abstracts	6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide	
	6,9-methano-2,4,3-benzodioxathiepin-6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9-hexahydro-3-oxide	
CAS registry numbers	alpha (α) endosulfan	959-98-8
	beta (β) endosulfan	33213-65-9
	technical endosulfan *	115-29-7
	endosulfan sulfate: * stereochemically unspecified	1031-07-8
Trade name	Thiodan®, Thionex, Endosan, Farmoz, Endosulfan, Callisulfan	

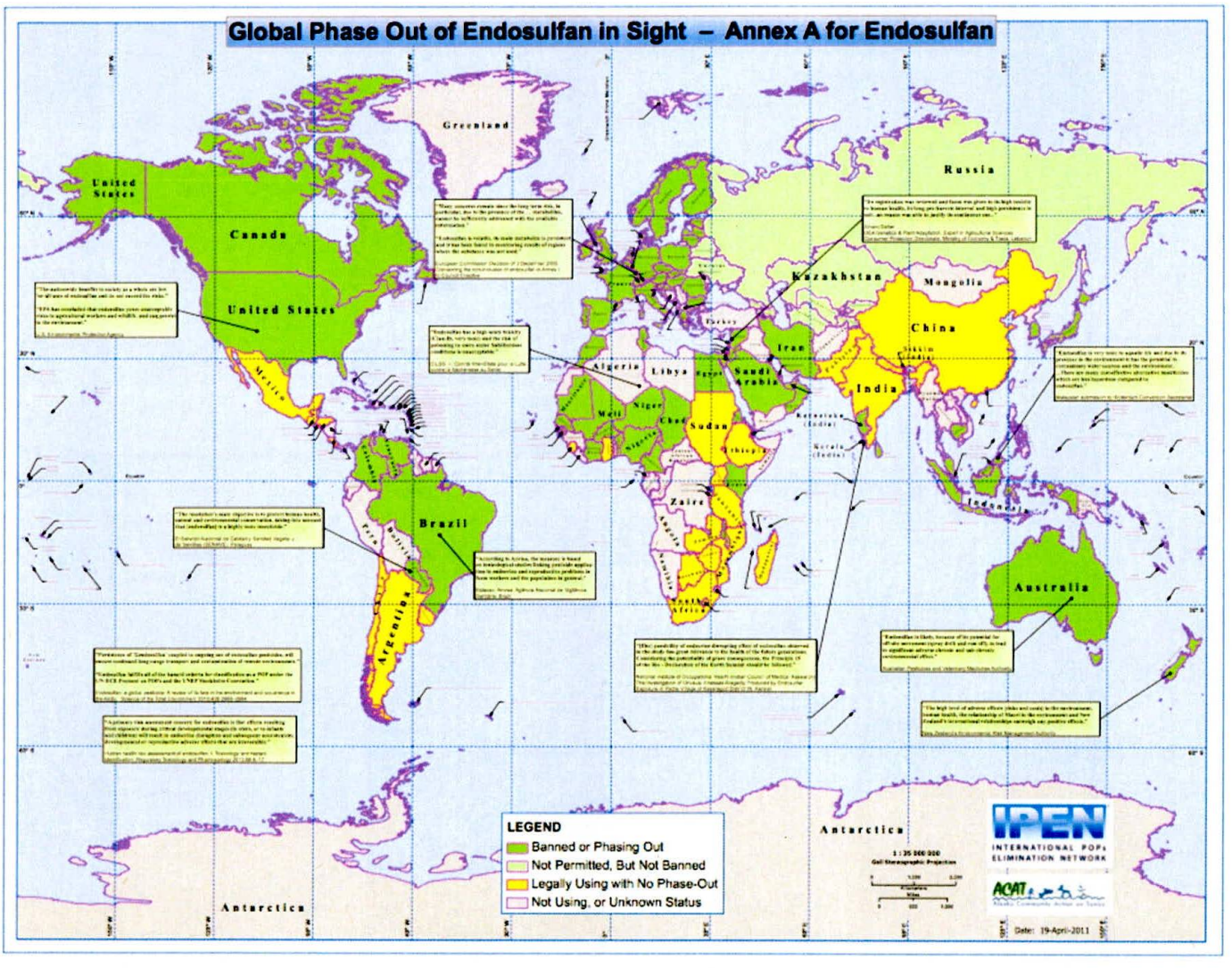
1. Figures D: Pests targeted by the endosulfan pesticide

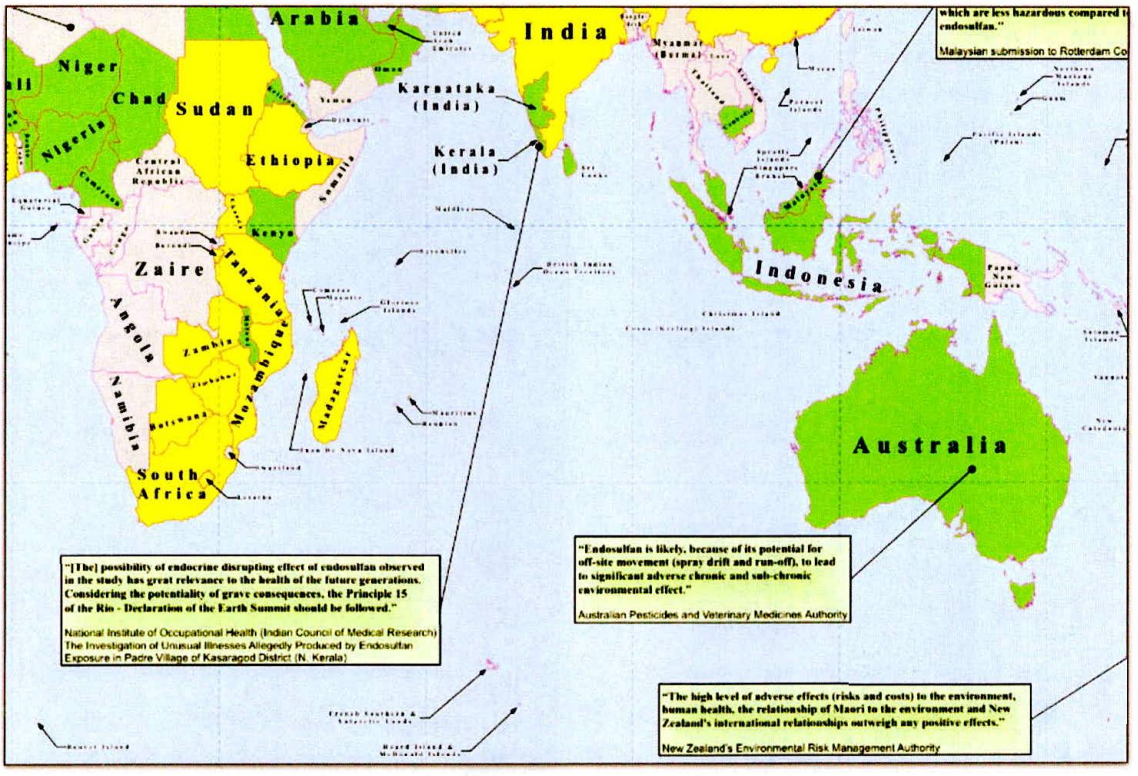
2. http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx

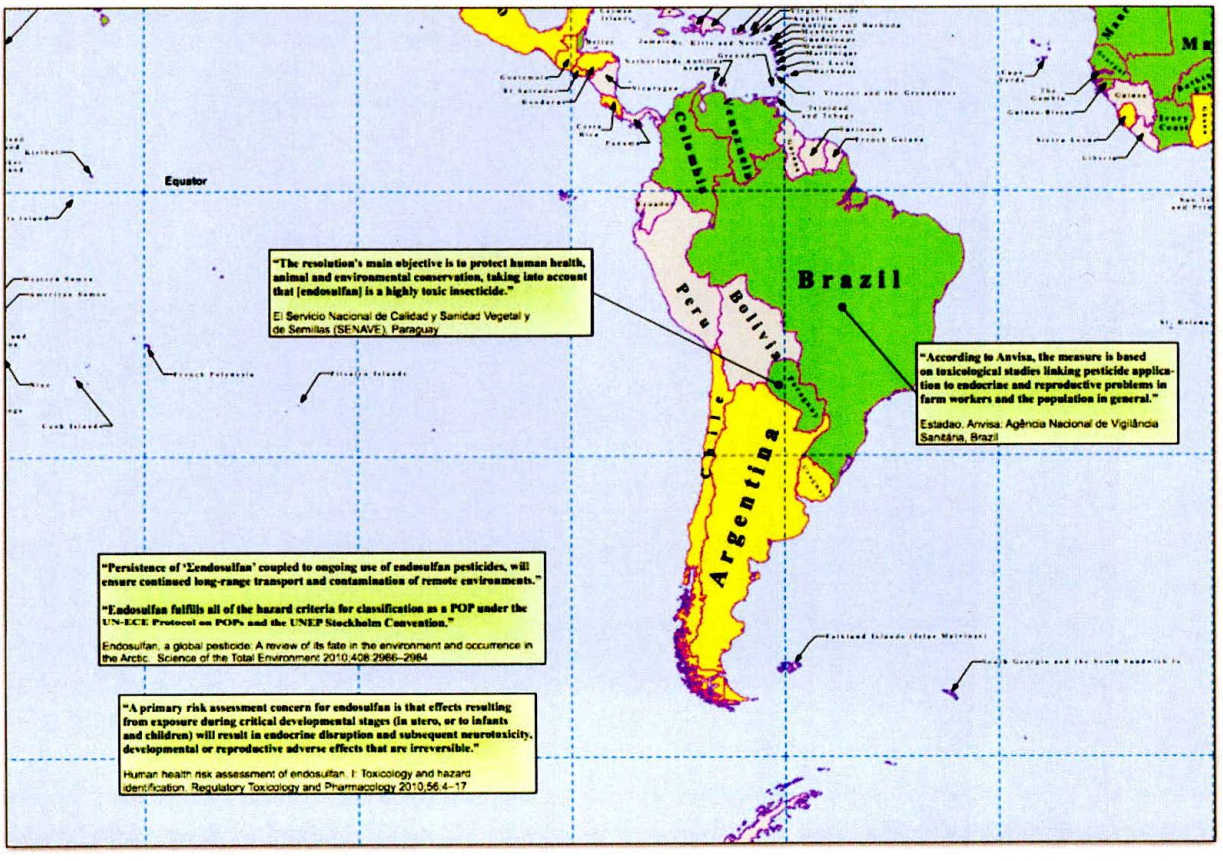
Crop	Pest
Apple	Aphids
Arhar, gram	Aphids, caterpillars, pea semilooper, pod borer
Bean, cowpea	Aphids, leaf miner, whiteflies
Chilli, onion, potato	Aphids, jassids
Coffee	Berry borer, stem borers
Cotton	Aphids, cotton bollworm, jassids, leaf rollers, pink bollworm, thrips, whiteflies
Eggplant, okra	Aphids, diamondback moth, jassids, shoot and fruit borer
Groundnut	Aphids
Jute	Bihar hairy caterpillar, yellow mite
Maize	Aphids, pink borer, stem borers
Mango	Fruit flies, hoppers
Mustard	Aphids, gall midges
Rice	Gall midges, rice hispa, stem borers, white jassid
Tea	Aphids, caterpillars, flushworm, mealybugs, scale insects, smaller green leafhopper, tea geometrid, tea mosquito bug, thrips
Tobacco	Aphids, oriental tobacco budworm
Tomato	Aphids, diamondback moth, jassids, leaf miner, shoot and fruit borer, whiteflies
Wheat	Aphids, pink borer, termites

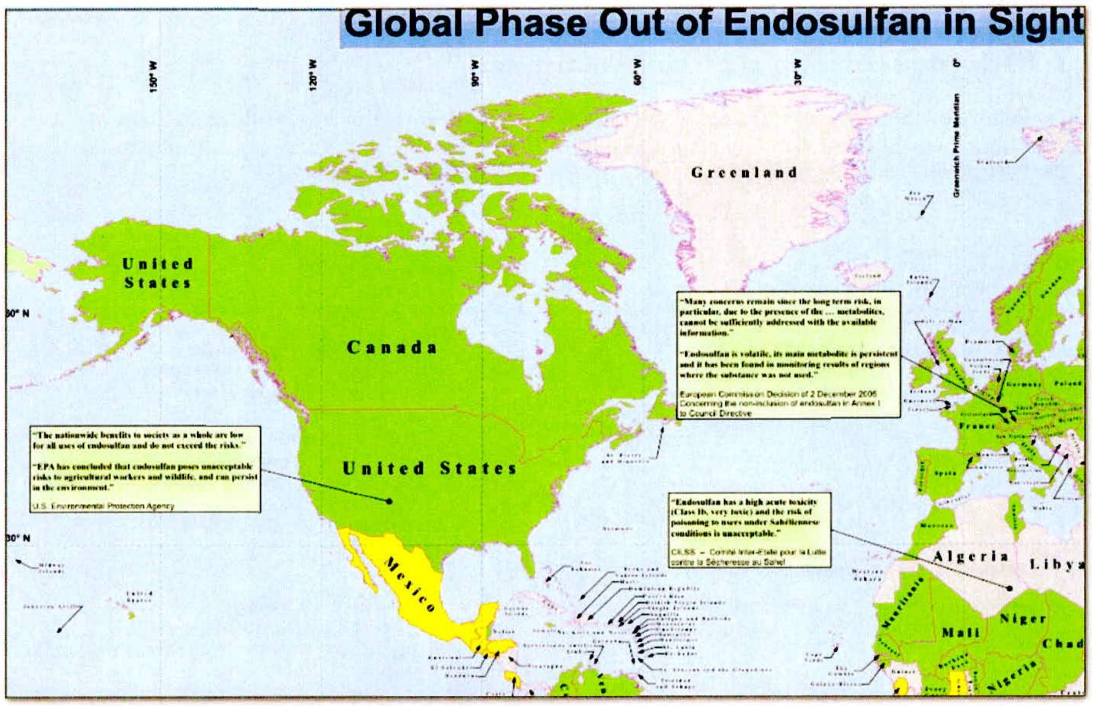
1.Figures E, F, G and H International POPs Eliminaton Network map of endosulfan use in, 2001, before Indian ban

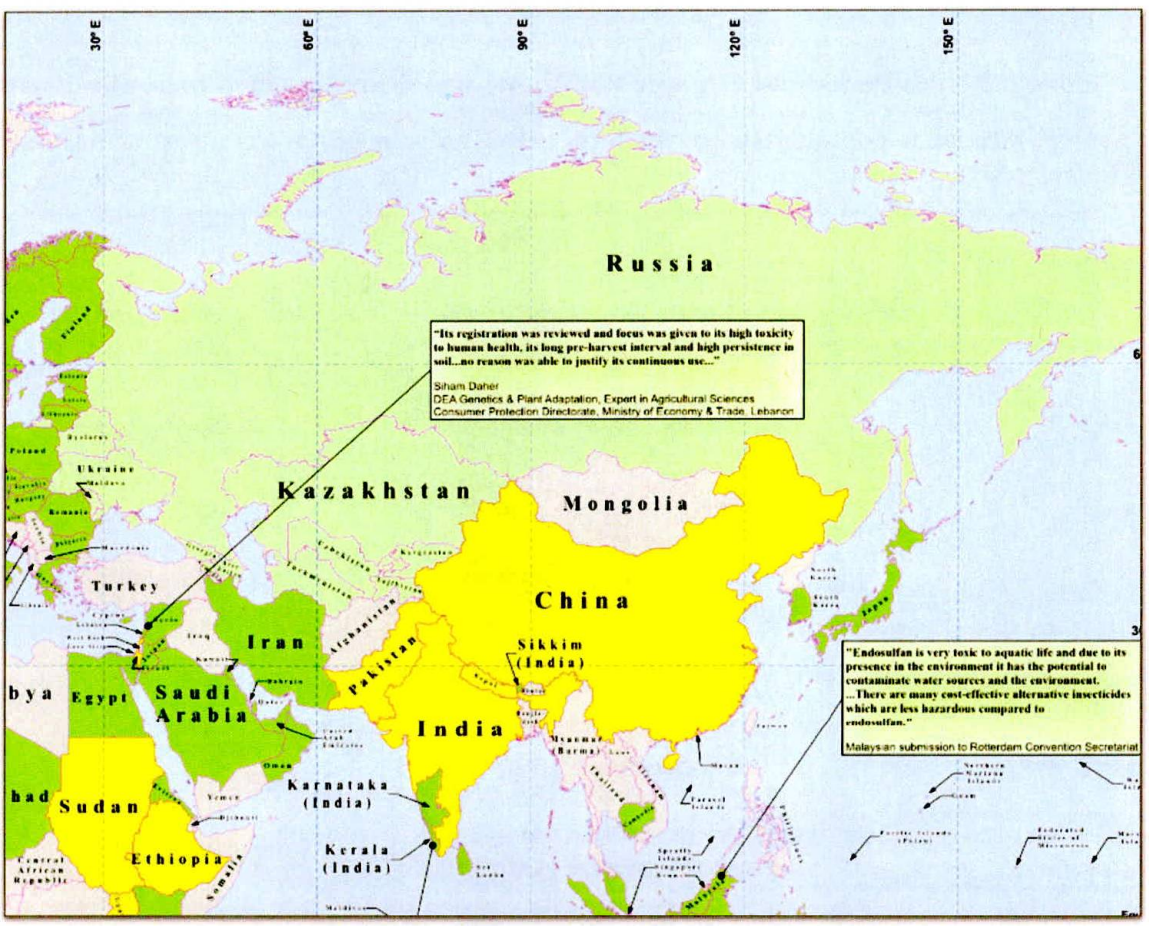
2. source: http://ipen.org/cop5/wp-content/uploads/2011/04/World-Endosulfan-map.pdf; 06.11.13; 09:07; and in THANAL presentation of the ban endosulfan cmapain, written by Jayakumar C.




Arabia
India
Niger
Chad
Sudan
Nigeria
Karnataka (India)
Kerala (India)
Ethiopia
Kenya
Zaire
Tanzania
Angola
Zambia
Mozambique
Namibia
Botswana
Madagascar
South Africa
Indonesia
Australia
which are less hazardous compared t endosulfan."
Malaysian submission to Rotterdam Co
"[The] possibility of endocrine disrupting effect of endosulfan observed in the study has great relevance to the health of the future generations. Considering the potentiality of grave consequences, the Principle 15 of the Rio - Declaration of the Earth Summit should be followed."
National Institute of Occupational Health (Indian Council of Medical Research) The Investigation of Unusual Illnesses Allegedly Produced by Endosulfan Exposure in Padre Village of Kasaragod District (N. Kerala)
"Endosulfan is likely, because of its potential for off-site movement (spray drift and run-off), to lead to significant adverse chronic and sub-chronic environmental effect."
Australian Pesticides and Veterinary Medicines Authority
"The high level of adverse effects (risks and costs) to the environment, human health, the relationship of Maori to the environment and New Zealand's international relationships outweigh any positive effects."
New Zealand's Environmental Risk Management Authority


Equator
Colombia
Venezuela
Brazil
Peru
Bolivia
Chile
Argentina
"The resolution's main objective is to protect human health, animal and environmental conservation, taking into account that [endosulfan] is a highly toxic insecticide."
El Servicio Nacional de Calidad y Sanidad Vegetal y de Semillas (SENAVE), Paraguay
"According to Anvisa, the measure is based on toxicological studies linking pesticide application to endocrine and reproductive problems in farm workers and the population in general."
Estadao, Anvisa: Agência Nacional de Vigilância Sanitária, Brazil
"Persistence of 'Σendosulfan' coupled to ongoing use of endosulfan pesticides, will ensure continued long-range transport and contamination of remote environments."
"Endosulfan fulfils all of the hazard criteria for classification as a POP under the UN-ECE Protocol on POPs and the UNEP Stockholm Convention."
Endosulfan, a global pesticide: A review of its fate in the environment and occurrence in the Arctic. Science of the Total Environment 2010;408:2986–2984
"A primary risk assessment concern for endosulfan is that effects resulting from exposure during critical developmental stages (in utero, or to infants and children) will result in endocrine disruption and subsequent neurotoxicity, developmental or reproductive adverse effects that are irreversible."
Human health risk assessment of endosulfan. I: Toxicology and hazard identification. Regulatory Toxicology and Pharmacology 2010;56:4–17


Global Phase Out of Endosulfan in Sight
Greenland
United States
Canada
United States
Mexico
"Many concerns remain since the long term risk, in particular, due to the presence of the ... metabolites, cannot be sufficiently addressed with the available information."
"Endosulfan is volatile, its main metabolite is persistent and it has been found in monitoring results of regions where the substance was not used."
European Commission Decision of 2 December 2006 Concerning the non-inclusion of endosulfan in Annex I to Council Directive
"The nationwide benefits to society as a whole are low for all uses of endosulfan and do not exceed the risks."
"EPA has concluded that endosulfan poses unacceptable risks to agricultural workers and wildlife, and can persist in the environment."
U.S. Environmental Protection Agency
"Endosulfan has a high acute toxicity (Class Ib, very toxic) and the risk of poisoning to users under Sahelienese conditions is unacceptable."
CILSS – Comité Inter-Etats pour la Lutte contre la Sécheresse au Sahel
Algeria
Libya
Mali
Niger
Chad
Nigeria


Russia
"Its registration was reviewed and focus was given to its high toxicity to human health, its long pre-harvest interval and high persistence in soil...no reason was able to justify its continuous use..."
Siham Daher
DEA Genetics & Plant Adaptation, Expert in Agricultural Sciences
Consumer Protection Directorate, Ministry of Economy & Trade, Lebanon
Kazakhstan
Mongolia
China
Turkey
Iran
Pakistan
Sikkim (India)
India
Egypt
Saudi Arabia
Sudan
Ethiopia
Karnataka (India)
Kerala (India)
"Endosulfan is very toxic to aquatic life and due to its presence in the environment it has the potential to contaminate water sources and the environment. ...There are many cost-effective alternative insecticides which are less hazardous compared to endosulfan."
Malaysian submission to Rotterdam Convention Secretariat

1.Figure I: Estimated costs for replacing endosulfan

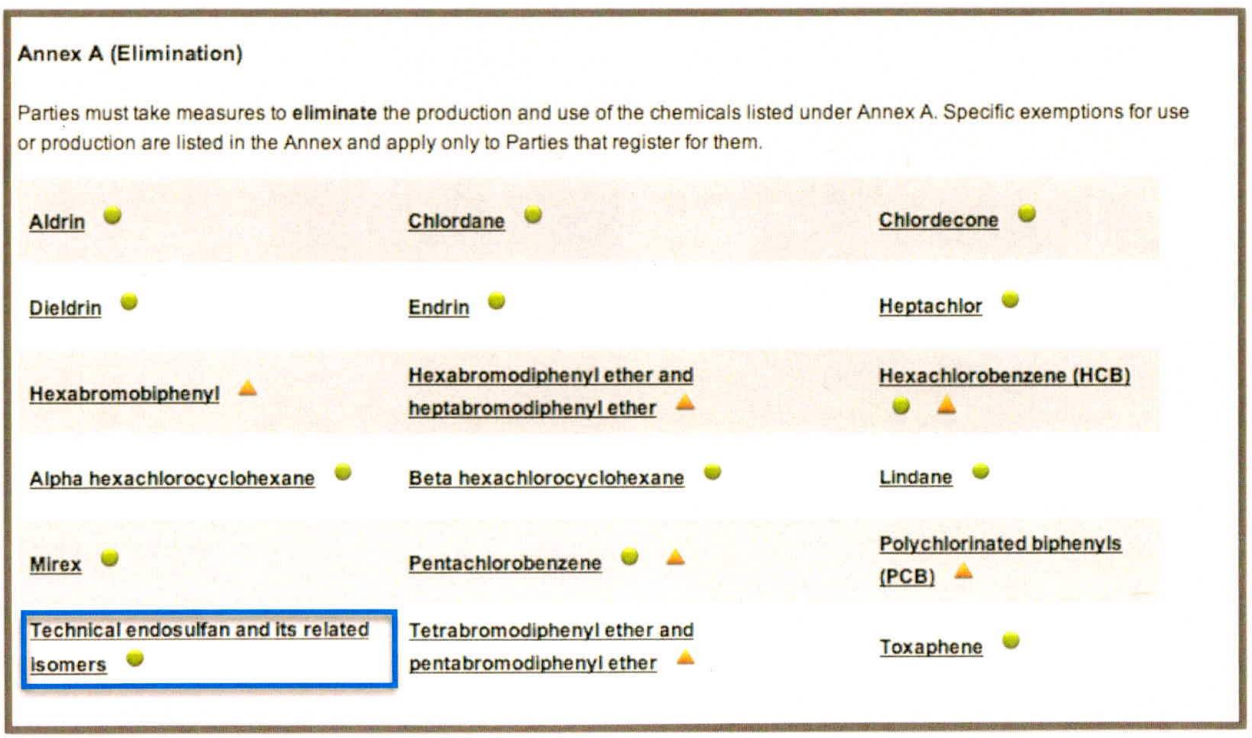
2. source: p.5, Report of the Persistent Organic Pollutants Review Committee on the work of its sixth meeting, Addendum, Risk management evaluation on endosulfan, UNEP/POPS/POPRC.6/13/Add.1; http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx; 23.10.13; 19:54

3.

Chemical alternatives		
Cost impact factor	**Expected impact**	**Expected costs if endosulfan would be replaced by chemical alternatives**
Yields	Remain stable	Annual cost will increase between 0 and $40 million US Brazil: 0 to $13.87 million US[22] India: 0 to $9.63 million US China: 0 to $7.89 million US Argentina: 0 to $2.89 million US USA: 0 to $2.78 million US Rest of the world: 0 to $9.28 million US
Prices	Remain stable	
Production costs	Plant protection cost increase by 0 to 40%	
Non-chemical alternatives		
Cost impact factor	**Expected impact**	**Expected costs if endosulfan would be replaced by non-chemical alternatives**
Yields	Slight decrease to slight increase	Significant non-quantified annual economic benefit
Prices	In organic production significant price premiums	
Production costs	Significant change of plant production costs possible.	

1.Figure J: List of Persistent Organic Pollutants which are destined to be eliminated

2.source: http://chm.pops.int/TheConvention/ThePOPs/ListingofPOPs/tabid/2509/Default.aspx; 9.10.13; 17:38)



1.Figure K: Countries that are part of the Stockholm convention

source: http://chm.pops.int/Countries/StatusofRatifications/tabid/252/Default.aspx; 9.10.13; 17:38)

Annex 2: Definitions

- **breast milk**: milk produced by women after childbirth, produced newly everyday thanks to prolactin, a hormone. Hormones such as estrogen, progesterone, prolactin, and lactogen enable the formation of milk. (http://www.nlm.nih.gov/medlineplus/ency/article/002451.htm; 20.10.13; 00:46)
- **adipose tissue**: tissue containing fat cells, or adipose cells, which specialise in synthesising and contain fat globules. The tissue is found under skin, between muscles, in the intestines, around the heart, among other places. The fat stored in this tissue comes either from ingested materiel or is synthesised in the body. (http://www.britannica.com/EBchecked/topic/5948/adipose-tissue; 20.10.13; 01:10)
- **placental tissue**: tissue situated in the placenta, the organ which forms the lining of the uterus, when the uterine unifies with the membranes of the foetus. It provides nourishment for the foetus and eliminates its waste. (http://dictionary.reference.com/browse/placenta; 20.10.13; 1:30)
- **umbilical cord blood**: it is the blood left in the placenta and umbilical cord after the baby is born (http://www.marchofdimes.com/pregnancy/umbilical-cord-blood.aspx; 20.10.13; 01:37)
- **cerebral palsy**: this disorder concerns movement, muscle tone or posture, and it is caused by the damage to the immature or developing brain, often before the birth of the child (http://www.mayoclinic.-com/health/cerebral-palsy/DS00302; 21.10.13;12:13)
- **retardation of mental or physical growth**: problems that hold back the physical or mental development of a person (Apple dictionary)
- **epilepsy**: epilepsy is a disorder of the central nervous system in which nerve cell or neurone activity is disturbed resulting in seizure which is a state in which a person experiences abnormal behaviour which can vary : staring blankly for a few seconds, twitching or convulsions, loss of consciousness etc. (http://www.mayoclinic.com/health/epilepsy/DS00342; 21.10.13; 12:29)
- **skeletal limb abnormalities:** problems in the bone structure of arms and legs, usually happening in utero. It can disturb normal growth.

http://www.healthline.com/health/skeletal-limb-abnormalities?toptoctest=expand; 21.10.13; 12:29)

Annex 3: Interviews

Tuesday 9th July 2013

Jayakumar C., zoologist, one of the founders of THANAL (Conservation, Action and Information Network), activist

Hopeful to get more information in India, I went to the THANAL office. In the beautifully situated office of THANAL, in Jawahar Nager, Kowdiar, Trivandrum, we first started talking about agriculture in general, and Mr. Jayakumar explained that the government encouraged the use of chemicals, as many of these substances were subsidised goods. (see Chapter 9 on alternatives)

THANAL as an NGO got involved in the endosulfan issue when Sreemati Leelakumari asked for help. They went to the region and created a type of social interaction in the community. Since the start of the aerial spraying by the Plantation Corporation Kerala, people had started noticing that snakes, jackals and birds were dying. This wasn't a problem until cows and goats began dying as well- at this point there had been a petition in 1979 and an official complaint. Unfortunately, they found it impossible to defend this complaint, and it was termed an allegation. Cashew was a cash crop and the spraying was taking place about thrice every year. When Sreemati Leelakumari moved into the region, she decided to take legal redressal measures.

One reason why the substance was affecting people so much is probably because in the 1960s there had been land reforms in Kerala, when a communist party came officially to power through a democratic election. It remained in power for a few years only, but it was enough for the feudal system in Kerala to be completely changed. Each person cultivated his or her own land. Furthermore, it can be said that due to the fertility of the land, people were attracted to Kerala, and it is indeed one of the most densely populated regions in India.

In 1979, a journalist and farmer, Shree Padre, wrote for the first time about the problem in his article "Life is cheaper than cashew". A deformed cow had been born in his village in Kaserged. Humans too were inevitably affected. The farmers themselves used to initially stand on the border of the plots, to show where the helicopters should spray the chemical. Thus being fully exposed to the chemical. In 1991, the government of the Philippines asked for a global ban. But to no avail

In 1997, Dr. Mohan Kumar wrote about the situation in Kasargod where all the families living around a particular stream were having handicapped children. Endosulfan would later be proved to be a neurotoxine and a genotoxine. In 2000, a person from Pesticide Action Network Asia-Pacific came to investigate on the problem and concluded that it was indeed endosulfan that was causing the problems. It was then described how endosulfan isomers α- and β-endosulfan break down into endosulfan sulphate when heated, which is a substance which is persistent in soil, water, air and fat. Its half-life is around 800 days. In 2002, the state of Kerala also demanded a global ban.

When the case went to court in Kerala in 1998, the main argument of the lawyers is the article 21 of the Indian constitution, which guarantees a right to live. Finally, the court case ruled in their favour,

and aerial spraying was stopped in 2003, since they deemed that "human life is more important than the possible monetary losses", whether endosulfan was a POP (Persistent Organic Pollutant) or not. Subsequent international concern for endosulfan use was raised, and the Stockholm Convention investigated the question. (see Chapter VIII. The Legislation linked to endosulfan, and pesticide use, section B)International Environmental Law- Stockholm Convention).

The issue was that endosulfan had a socio-economic impact, and that a global ban would stop the bio-accumulative and the long-range transport of the molecule (called the grasshopper effect: endosulfan can be carried through the air, so much so that breast milk samples in Denmark and Finland had clear traces of endosulfan).

An intriguing criticism was made by Jayakumar: it seems that healthcare that is administered in the world is 93% palliative, and 7% preventive. In medical schools for example, very little is taught about such extensive toxicological aspects.

Another shocking fact that was mentioned during the interview was that Israel had published a study back in 1979, which said that endosulfan could cause brain damage, but hadn't come to global attention. This was a few years after endosulfan was introduced in Kerala. Around 9000 to 10000 people suffered direct health problems in Kasargod according to Jayakumar, who worked in Kasargod itself to prove the link between the pesticide and the effects observed.

After the ban of pesticides in India, many of the alternatives that have been suggested are biological, and this is a milestone for agro-ecology.

Jayakumar and his wife Usha are both founders of THANAL, and they have dedicated their lives to the safeguard of the environment.

Saturday 13th July 2013

Sreemati Leelakumariamma, agricultural specialist

"What has been done to the land and to the people causes me much pain" said Agricultural officer Sreemati Leelakumari who worked for the Plantation Corporation of Kerala for many years, and distributed endosulfan as part of her job. "I would tell the farmers to be very careful with it, as a pesticide was actually poison (vesham), not to be considered as medicine (marunne)." she says of the toxic substance. Even worse were the aerial sprays. After buying the land on which her house was built, close to cashew crops in Kasargod, her husband, children and she moved into a barren land. " The aerial spraying would take place three times a year and the helicopters would fly over the entire countryside "There were no wild boars, no frogs and no fish in the river." A year went by and she noticed that her son was getting skin problems, and that he was having trouble breathing. She also realised that the local people were facing increasing health problems, as well as fewer fish to eat. As a mother, a citizen and a human being, she felt responsible; she had studied about pesticides in university and knew the health problems had something to do with them. She filed a case in 1997, literally taking the company that employed her to court. "Everyone was against it, the people, my husband (who also worked for KPC) and the policemen." She triggered a social movement that would change the international classification of endosulfan.

Thanks to her, endosulfan was first banned in Kerala in 2001, and with the help of THANAL, an NGO that fought for the ban till the end, an international ban was issued in October 2012 and in India this was valid from May 2013 onwards.

Sreemati Leelakumari received many awards and books have been written describing her key role.

Saturday 13th July 2013

Dr. Mohamed Asheel, MBBS, MPH, MDP Asst. Nodal Officer Rehabilitation of Endosulfan Victims Govt. of Kerala

As we reached the hospital of Kahnagad, a city in Kasargod, around midday, and we had a much awaited interview with the doctor who had convinced the international panel of the Stockholm Convention of the dangers of endosulfan use. Dr Asheel is a young doctor who recently completed his Master's Degree in Public Health. He literally risked his life whilst campaigning for the ban of endosulfan, standing up against pesticide companies and going to court as a doctor backed only by scientific evidence. He kindly gave me the text of his presentation and I wrote the "Epidemiology " section thanks to this document he had compiled, that had convinced an international committee and a nation.

He started by explaining how he got involved with the issue: he was asked by a professor in university to visit Kasargod when the media became very preoccupied with the endosulfan story. He left Trivandrum, not expecting to find much. He reached Kahnagad, and enquired into the whole affair. When he realised the scale of the social, environmental and health problems linked to endosulfan, he decided to act. He researched and found out about the Stockholm Convention, and realised that the only NGO participating was THANAL from Kerala.. He contacted Jayakumar at THANAL, decided to accompany him to the conference held in Geneva, to present the medical evidence concerning the hazards of endosulfan.

As he explained the politics involved in the conference, I was totally baffled by the influences that the industry had on governments! The only way was to ensure that THANAL and the inhabitants of Kasergod had political support on their side as well. The government of India, the world's largest producer of endosulfan, opposed the ban.

However, the then ruling chief minister of Kerala V. S. Achuthanandan, supported the campaign to ban endosulfan, and while the Stockholm Convention Conference was going on, there was even a hunger strike in Kerala for the global ban of endosulfan. This helped convey the seriousness of the issue to the world. What really interested me were all the complications linked to influence, power and the simple question of who made a decision. In the end it was pure and simple politics.

The scientific facts were clear, the use of endosulfan was dangerous, and endosulfan levels in people were extremely high. For example, in a scientific publication describing the concentrations of chemicals in breast milk in Bhopal (Madhya Pradesh, India), it stated that endosulfan concentrations were 8.6 times higher than the average daily intake level recommended by the WHO. His whole presentation was shocking, compelling and well put together.

In the end, the Stockholm convention listed endosulfan as a chemical to be phased out, but India temporised, only agreeing to ban endosulfan in Kerala and Karnataka, the regions where there had been problems. The reaction was immediate, and the Democratic Youth Federation of India, which is a youth communist party in Kerala went to the Supreme Court of India to demand a national ban. The ban was subsequently given by the court. (See Chapter VIII "Legislation Section", under point c: "Endosulfan Ban").

Dr Asheel is currently working on the rehabilitation of endosulfan victims and designing a list of people who will benefit from state support.

Sunday 14th July 2013

Dr. Mohankumar Y. S., MBBS, worked in Kasargod for more than 30 years

It was a cool Sunday morning when we set off from the hotel in which we had stayed in Kasargod. We were leaving that evening and had one more important person to visit. Many of the interviewees had quoted him as a dedicated doctor, who had held accurate records which had played a crucial role in giving clear evidence against endosulfan. As we drove up from the coast to one of Dr. Mohankumar's clinics in an area close to the Karnataka border, the region got more hilly, and when we stopped to get directions, we noticed that even the language had changed. As we reached what looked like a building in the middle of the road, I could not help but notice the small crowd of people and a few cars, for this was the time the doctor was there. We waited until he had finished with his consultations. When we started the interview, we talked about the fact that the cashew plantations had been replaced with rubber plantations. This was of course after the whole endosulfan issue. The only chemical used at present is copper sulphate, for nitrogen fixing.

The doctor had started working in the region in 1982, exactly six years after the first endosulfan spraying. It used to be done almost 70m above the trees. This chemically affected everyone. There were three clinics in this rural region bordering Karnataka, but before the use of pesticides the place was pristine and people were healthy.*"There was practically no anemia or malnutrition, which was great and indicated an ideal place, this place is actually called Swarga (heaven)"* he said, indicating the road-sign. Natively from the region, Dr Kumar had studied medicine and returned to the countryside where he has been practicing for the past thirty-one years.

During the initial years, the doctor noticed many strange diseases and that each house had 3 to 4 sick people. The diseases were both psychiatric and physical, and at that point he wrote to senior doctors in the neighbouring towns. No serious investigation was initiated by the State. Slowly, more effects could be seen within the population such as more epilepsy, miscarriage and other abnormalities, in children and adults.

The helicopters flew twice a year, and the precautions stated that the area that had been sprayed could not be entered for at least 15 days. This regulation could never be respected; it was just unrealistic. "Harvesting is done between March and April, and it takes four people to harvest a kilogram of cashew, they have to eat during the season and this despite the water contamination or pesticide sprays.

Boiling water also worsens the effect of endosulfan, because it becomes a sulphate. *"Swarga (heaven) became a living hell."* said Dr. Mohankumar about the horrors of pesticide exposure. In 1997, he wrote an article in the Kerala Medical Journal about these toxic effects on the population, and stating the probable cause as endosulfan, however this was very difficult to prove. There were only two places in India where aerial spraying had been used: one was Kerala, the other Karnataka (the neighbouring state). Similar abnormalities were recorded in Daramsala, Karnataka, although there were fewer reactions than in Kerala.

However, since the endosulfan ban came to Kerala in 2001, following the court case won by Sreemati Leelakumari, there has been a noticeable decline in such cases according to Dr. Mohankumar. After twenty five years of spraying and another ten to fifteen years of exposure to the residue in the environment, the exposure has been significant, but after 2001, the effects significantly decreased: there are fewer miscarriages and abnormalities. In the last five years no case of birth abnormality has come to Dr Mohankumar. But society will have to take care of the victims, and wait for another two generations to be really rid of genetic anomalies.

As for relief for the victims, there has been the building of "bud-schools", that provide physiotherapy and teach disabled children with physical and mental handicaps.Eleven such schools were built.

Dr. Mohankumar took part in a national television debate on social issues directed by Aamir Khan, a veteran film director, in a nationally televised programme called Satyamev Jayate, exposing the endosulfan scandal and testifying the reduction of miscarriages after the stop of the areal sprays. He was later sued and harassed by the pesticide companies, but the people of the region defended him.. ***His observations provided scientific evidence for the toxicity caused by endosulfan***

Tuesday 30th July 2013

Dr Pradhyumna, MBBS, MSc Public Heath, responsible for research and training interests in Environmental Health and Epidemiology, SOCHARA, Bangalore, India

A few weeks after my visit to Kasargod, I went to Bangalore, one of the biggest cities in South India. There my uncle took me to the SOCHARA (Society for Community Health Awareness Research and Action) office, where I met a doctor who is also very interested in the environment. I interviewed him mainly about the state of environmental health in India. *"Environmental Health as a subject is evolving on a global scale, the most basic definition of it is actually: How does the environment impact human health, and specifically how do changes in the physical, chemical and biological characteristics of the environment impact human health."* he pointed out. He continued by saying that in India the environment is not taken seriously enough. More emphasis is given to the industry. Even farmers, who know that pesticides are bad for health, use them. Hence they always cultivate some crops without pesticides and keep it for the family. Political will is actually crucial when it comes to such issues, and politics is linked to economics. In our world, it seems difficult to change the fact that the poor become poorer and the rich become richer. Many inter-

national companies come to India, because the rules are easier to get around. After this conversation, it was rather difficult to ignore the blatant injustice that certain people in India are facing. ***But here again he mentioned the Kasargod case as a unique situation where one pesticide was used, and this enabled people to identify it and prove the dangers of the environmental pollutant, thanks to temporality- the fact that after the ban, the situation improved.***

Saturday 13th July 2013

Professor M. A. Rahman, documentary producer, writer, retired Professor and social activist

Professor G. B. Valsan,writer, retired Professor and social activist

On Saturday 18th July, we drove into a beautiful area with trees of all shapes and shades of green, it was actually a residential area. There we met retired professors, or rather professors who had merely changed their profession. They had actively participated in the fight to ban endosulfan, and most recently written a book, and Prof Rahman made a film documentary about the issue. They also had set up an organization to help the victims. Thanks to them, I really understood the socio-political and geographical aspects of the problem.

Professor, or rather "Master" Rahman , as college teachers are called in the region, started to explain that Kasargod is near the Western Ghats, a region with 14 rivers flowing down the hills to the sea. There are many forests and throughout the centuries the region has been coveted by many .The region boasts the existence of eight forts. The agriculture too was maintained and protected until the 1970s Green Revolution. It is known that cashew is a crop that was brought by the Portuguese in the 15th century, to avoid soil erosion. In the context of the Green Revolution, mono-culturing became a new trend and 5000 hectares were solely used for cashew. First the pesticide used was endrin and it was sprayed manually. When the decision to have aerial spraying of endosulfan was taken, the very politically active region of Kasargod was unhappy, and small protests took place. This first issue was not the pesticide poisoning, but the loss of jobs that it would be creating. The decision to use aerial spraying was nevertheless supported, and carried out, after all it was the Green Revolution, and no other political action was taken.

"Kasargod is unique as this one part of Kerala has 7 languages, which are Tulu, Kannada, Malayalam, Urdu, Konkanni, Biyarii and Marati. This could explain the lack of communication between the communities and the fact that the health hazards took so long to be reported."

Furthermore there are communal, ethnic and religious tensions unlike in the rest of Kerala. In this northern region, there is a lot of "framing". People commit some acts of vandalism and accuse their opponents of the crime. Politics play a major role in the region, for example the question of whether the learning of Malayalam is necessary was highly debated. It is quite shocking, but many people living in Kasargod do not speak the language of the region: Malayalam.

Since the cashew plantation was a monoculture, nitrogen fixing would not be renewed, which was a long-term problem. As the first environmental movement in India, the Silent Valley, took off, Kasar-

god was peaceful, or so it seemed. In reality, the biodiversity was highly affected and was being destroyed.

The highly moist topography of the area was not taken into account when the use of endosulfan started. Despite regulations that clearly stipulate that there mustn't be any spraying on water bodies (eg. rivers) and that it should be done at 5 meters of distance from the ground, the spraying was done in a very wet region, and from the skies, which means at a height that was much more than 5 meters. The local population suffered, those who took the decisions however, stayed away from the region.

Up in the villages, people went on with their daily lives, eating contaminated livestock, and drinking the water.

Dr Mohan Kumar helped a lot by writing detailed observations of the victims, diseases like cerebral palsy or hydrocephalus. He recorded 150 houses where there were affected people. The Centre of Science and Environment of India (CSE) works on a national level, but they took a long time to see the problem. Some people still maintain that there is no problem. However the National Institute of Occupational Health has made a formal report on the situation, in which many experts from all over the country give a verdict. The article by Shree Padre published in 1979 is also an interesting source.

After the Green Revolution food went from being organic to exactly the opposite. The argument that is repeatedly used is the higher yield that could be collected. Some say that this is not true and that absolutely no higher yield can be noted.

An organisation named ENVISAGE (Endosulfan Victims Support Group) was set up two years back by activists, including the interviewees. Masters Valsan and Rahman have written extensively about the subject in Malayalam magazines. Six groups in the Arabian Gulf are currently active and many people help ENVISAGE. The aim is to help the victims by setting up palliative care facilities, for example.

Annex 4: Kerala's Chief Minister's view on the endosulfan ban

V. S. ACHUTHANANDAN
CHIEF MINISTER OF KERALA

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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.

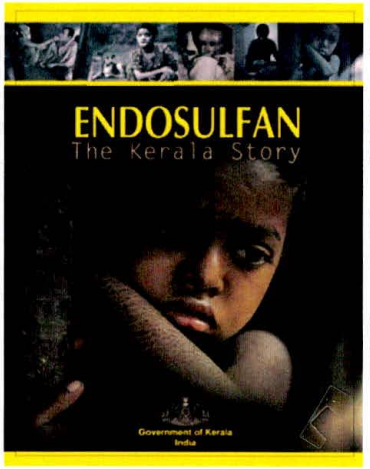
This report is a mark of our struggle against the use of endosulfan, a reflection of what has happened in part of our state and what we are doing to rehabilitate them and a hope for safer healthier nation and world.

V.S. Achuthanandan.

Thiruvananthapuram, Dated 22nd April, 2011.

Forward of the Kerala Chief Minister in the document that was released by the Government of Kerala in 2011.

1. source:Endsulfan: the Kerala Story, http://www.cseindia.org/userfiles/endosulfan_kerala_story.pdf; 28.10.13; source:



Document Government of Kerala in 2011 about endosulfan

1. source:Endsulfan: the Kerala Story, http://www.cseindia.org/userfiles/endosulfan_kerala_story.pdf; 28.10.13;

Annex 5: Stockholm Convention Document

(XXVII.15)

UNITED NATIONS NATIONS UNIES

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Reference: C.N.703.2011.TREATIES-8 (Depositary Notification)

STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS
STOCKHOLM, 22 MAY 2001

ADOPTION OF AN AMENDMENT TO ANNEX A

The Secretary-General of the United Nations, acting in his capacity as depositary, communicates the following:

At its fifth meeting held in Geneva from 25 to 29 April 2011, the Conference of the Parties to the above Convention adopted an amendment to Annex A by decision SC-5/3 to list the chemical "technical endosulfan and its related isomers" in the annex.

In accordance with paragraphs 3 (b) and 3 (c) and paragraph 4 of article 22 of the Convention, any Party that is unable to accept an amendment to Annex A, B or C shall so notify the depositary, in writing, within one year from the date of communication by the depositary of the adoption of the amendment. The depositary shall without delay notify all Parties of any such notification received. A Party may at any time withdraw a previous notification of non-acceptance in respect of any amendment to Annex A, B or C, and the amendment shall thereupon enter into force for that Party subject to paragraph 3 (c) of article 22. On the expiry of one year from the date of the communication by the depositary of the adoption of the amendment to Annex A, B or C, the amendment shall enter into force for all Parties that have not submitted a notification in accordance with the provisions of paragraph 3 (b) of article 22.

In accordance with paragraph 4 of article 22, an amendment to Annex A, B or C shall not enter into force with respect to any Party that has made a declaration with respect to any amendment to those Annexes in accordance with paragraph 4 of article 25, in which case any such amendment shall enter into force for such a Party on the ninetieth day after the date of deposit with the depositary of its instrument of ratification, acceptance, approval or accession with respect to such amendment.

The texts of the amendment to Annex A, as contained in the above-mentioned decision of the Conference of the Parties, in the six authentic languages are transmitted herewith.

27 October 2011

Attention: Treaty Services of Ministries of Foreign Affairs and of international organizations concerned. Depositary notifications are currently issued in both hard copy and electronic format. Depositary notifications are made available to the Permanent Missions to the United Nations at the following e-mail address: missions@un.int. Such notifications are also available in the United Nations Treaty Collection on the Internet at http://treaties.un.org, where interested individuals can subscribe to directly receive depositary notifications by e-mail through a new automated subscription service. Depositary notifications are available for pick-up by the Permanent Missions in Room NL-300.

Document of the Stockholm Convention

1. http://chm.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx; 06.11. 13; 09:17