National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

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Abstract

Endosulfan. A closer look at the arguments against a worldwide phase out

In 2007 the European Commission proposed a worldwide ban for the insecticide endosulfan. RIVM has investigated the validity of the arguments against a worldwide ban. Most of the arguments could be refuted after comparing them with scientific data. That suggests that trade interests play an important role in keeping endosulfan on the market. The investigations were carried out on behalf of the Dutch Ministry of Infrastructure and Environment.

The European Commission has proposed to list endosulfan to the annexes of the Stockholm Convention because of its chemical characteristics. The Convention aims to ban substances that are persistent, bioaccumulative, toxic and which can be transported over long distances. After nomination, three stages can be distinguished within the process to listing Firstly, a risk profile on the substance is drafted and discussed. The next year the risk management options are investigated and discussed and finally the decision to list the substance on one of the annexes to the Convention is made by the so-called Conference of Parties.

Keywords:
endosulfan, production, use, Stockholm Convention, POPs

Rapport in het kort

Endosulfan. De argumenten tegen een totaalverbod nader onderzocht

De Europese Commissie heeft in 2007 voorgesteld om het gewasbeschermingsmiddel endosulfan wereldwijd te verbieden. Het RIVM heeft onderzocht in hoeverre de argumenten die zijn aangedragen door voorstanders van het gebruik van endosulfan om een wereldwijd verbod op endosulfan te voorkomen valide zijn. Een groot deel van de argumenten bleek niet houdbaar nadat ze met wetenschappelijke gegevens waren getoetst. Bovendien lijken (handels)-politieke belangen een belangrijke rol te spelen bij een beslissing om het gebruik van endosulfan uit te faseren. Het onderzoek is in opdracht van het ministerie van I&M is uitgevoerd.

Vanwege de eigenschappen van endosulfan heeft de Europese Commissie voorgesteld om het middel toe te voegen aan het Verdrag van Stockholm. Dit verdrag beoogt stoffen die niet afbreken, zich ophopen in organismen, giftig zijn en over lange afstand kunnen worden getransporteerd wereldwijd te verbieden (zogeheten POP's). Het proces om tot een totaalverbod te komen verloopt na het voorstel drie stappen: beoordeling van wetenschappelijke gegevens over de stofeigenschappen, inventarisatie van de maatregelen die risico's moeten reduceren als de stof aan de criteria van het verdrag voldoet, en uiteindelijk een besluit over toevoeging van de stof aan het verdrag door de zogenoemde Conference of Parties.

Trefwoorden:
endosulfan, productie, gebruik, Stockholm Verdrag, POPs

Contents

Summary

In 2007 endosulfan has been nominated for inclusion in the Stockholm Convention, which aims at a phase out of substances which are persistent, bioaccumulative, toxic and that have the ability to be transported over long distances. The nomination has been supported by a large number of countries, but there were also some countries which supported the continued use of endosulfan. There arguments focussed on toxicity and safe use of endosulfan, export from the European Union, unilateral revision of the Maximum Residue Limits for endosulfan in tea, and the costs of alternatives. This report aims at analysing the arguments in support of continued use of endosulfan. First it explores the present production and producers, and marketing and use. In addition, attention is dedicated to the toxicity of endosulfan, the process of nomination of endosulfan for the Rotterdam Convention, Maximum Residue Limits (MRLs) for endosulfan and possible alternatives.

Endosulfan was placed on the market in the 1950's by Farbwerke Hoechst A.G., Germany and FMC Corporation and is at present being produced by nine companies. The original companies, which developed endosulfan, do not produce it anymore. At present the producing companies are located in China (3), India (3), the Republic of Korea (1), Israel (1) and Brazil (1). Endosulfan is distributed worldwide, but it is often difficult to identify where endosulfan used in a certain country has its origin. For 2010 worldwide production of endosulfan was estimated to range between 18,000 and 20,000 tonnes per year, of which 50-70% is produced by companies in India.

At present there are at least 70 countries that have prohibited the application of endosulfan, 32 of which have phased out endosulfan since 2005. In at least 40 countries endosulfan is still being registered. Of these, six have severely restricted the use of endosulfan and eight countries have scheduled a phase out in the near future. Information on other countries is lacking. Use in Europe and the United States, but also in Australia and New Zealand have decreased significantly since the 1990s.

Endosulfan is most applied on cotton. Application to cotton was registered in all 19 countries studied, and this also the crop requesting the highest amounts. In total endosulfan is applied to more than 100 different crops worldwide. For most crops there are only registrations in a few countries. For the crops apple, beans, cotton, maize, potato, tobacco, and tomato endosulfan is registered in more than 25% of the countries. Most of the crops are also registered in the countries that scheduled a phase out for the next years.

Problems with endosulfan can be related to its high toxicity for the aquatic ecosystem and for humans. Examples of incidents are provided in the report. Those problems were often the reason for restrictions or phase out.
For most of the crops alternatives have been identified, and most of these alternatives are, in contrast with some reports, off patented. Alternatives do not necessarily cost more than endosulfan.

Opponents of listing endosulfan under the Stockholm Convention forwarded a number of arguments against listing. Firstly, the toxicity of endosulfan was questioned stating that many farmers have used endosulfan safely. However, different cases worldwide confirm the high toxicity of endosulfan. The environmental effects of endosulfan became only clear in the 1980s when the

awareness for the environment increased and its toxic characteristics became clear. A search in the SCOPUS literature database showed that most publications on endosulfan and toxicity in scientific literature originate from India (108) and the United States (63). Referring to the incidents and the studies on toxicity, the remark that either endosulfan is safe or that there were no issues on endosulfan and toxicity until 2000 can be refuted.
Remarks about the fact that endosulfan is soft for honey bees did not carry any references to scientific publications, nor were they backed up with experimental data. Most scientific studies retrieved only compare a limited number of pesticides. Last US-EPA study from 2009 classified endosulfan as moderately toxic to bees. A collection of literature data on the toxicity of various pesticides was beyond the scope of this study, but would be worthwhile to provide the proper insight. Applied rate of application, which is relatively high for endosulfan compared to more specific insecticides, should considered in such a comparison.

On maximum residue limits (MRLs) remarks were made as if the European Union had unilaterally revised the European limits, thus forcing tea growers not to use endosulfan. Investigations showed that, although there is a lot of debate on endosulfan MRLs in tea, the limits are still the same as the first ones set in 1971.
The European Union was accused to nominate a substance for inclusion in the Stockholm Convention, while still exporting it. The EDIXIM database showed that export of endosulfan still takes place. Present European pesticide legislation only regulates marketing and use within the European Union. There is no legislation in place that prohibits the production of and the trade in pesticides other than the Stockholm Convention. Thus, nomination of endosulfan to the Stockholm Convention without exemptions is the proper way to prevent export by companies within the European Union.

Finally, several remarks were made on the alternatives. The complaint focussed on the fact that alternatives would be much more expensive and that it would only profit European multinationals as these alternatives are still patented. A literature search on insecticides for cotton, although not extensive, showed that several alternatives are present. The new insecticides spinosad and indoxacarb were mentioned in most cases. Indoxacarp is a patented insecticide, which is marketed by DuPont Agricultural Products, United States. Spinosad is also patented and marketed by Dow AgroSciences, United States. Most other alternatives are free of patent and are also produced by companies in developing countries. The statement that endosulfan is much cheaper than alternative products could be refuted by making a comparison to other insecticides by estimating the price per hectare. For most pesticides, and especially the newer ones, recommended dose per hectare is much lower than that of endosulfan, which can partly be explained by the higher specificity. Remarkable is that the Indian Central Institute for Cotton Research does not mention endosulfan as recommended insecticide for the most important pest species to cotton, the American bollworm. The data suggest that trade interests play a more important role in opposing listing than agricultural considerations.

The research showed that there are enough reasons to strive for listing of endosulfan in annex A of the Convention. Most remarks made could be easily refuted. The route to listing should take notice of the main crops to which endosulfan is applied and the phase out schedules applied in various countries.

1 Introduction

Endosulfan has been nominated for the Stockholm Convention in 2007. The convention aims to phase out substances that are persistent, bioaccumulative, toxic and that have the ability to be transported over long distances. After nomination the scientific committee under the Stockholm convention, the Persistent Organic Pollutant Review Committee (POPRC), first discusses the characteristics of the substance against the criteria and when the substance fulfils the criteria it discusses the risk management options in the next year. Subsequently, the committee advises the Conference of Parties whether the substances should be listed or not.
Since the first discussions in the scientific committee under the Stockholm Convention, between 2007 and 2010, a lot of information has been published on endosulfan. Within the Review Committee there were discussions on the nomination between Parties being in favour of listing and Parties opposing the listing of endosulfan under the Convention. Outside the Convention rooms endosulfan also draw significant attention in the media (see further references in annex 1). These publications were reason to explore the background of the statements made and to compare these with the available scientific information in order to serve the delegation of the Netherlands in the negotiations for the 5th Conference of Parties of the Stockholm Convention. A number of the arguments are listed below with their citations.
Arguments on toxicity. Most of these arguments suggest that endosulfan is relatively safe for man and environment.

- There are a large number of farmers who have safely used endosulfan
- There are only suspicions that endosulfan may have caused deaths
- None of the independent regulatory actions in many of the countries that have prohibited endosulfan have been based on incidences of adverse human health in any of these countries
- Endosulfan is the only 'in-use' generic pesticide known to be soft on pollinators such as Honey bees and beneficial insects. Most alternatives are known to be harmful to pollinators such has honeybees.
- Farmers used endosulfan extensively in cross pollinated crops where successful Honey bee pollination plays an important role.

Arguments on use in and export from the European Union. These arguments focus on the fact that the European Union aims for a phase out, but still use and exports endosulfan

- Why has the European Union reintroduced endosulfan in Italy despite a ban?
- Despite the prohibition of the use of endosulfan, two key members of the European Union, Italy and France, are using and exporting it.

Arguments on the Maximum residue limits (MRLs). These arguments suggest that the European Union tries to prohibit endosulfan in developing countries by implementing extremely low residue limits for endosulfan. The discussion focus especially on MRLs in tea.

- The push for a ban is being implemented through the regulatory actions as well as restrictive trade practices. EU has unilaterally revised the Maximum Residue Limits (MRLs) in tea and in doing so has moved away from the internationally accepted CODEX standards. Similarly, there have been restrictions on use of Endosulfan by Cocoa farmers in West Africa. These restrictions have resulted in elimination of Endosulfan as a choice of crop protection for farmers across 21 African countries which depend on EU as a market for their export.

- The European Union, citing health concerns, has refused to import Indian tea if growers use Endosulfan.

Arguments on alternatives. These arguments can be split up in two kinds. The first suggest that the costs of using the available alternatives are much higher than endosulfan, the second that a prohibition will benefit European companies producing the high priced alternatives.

- A ban will result in a replacement of endosulfan by alternatives which are ten times more expensive.
- Endosulfan costs just 240-250 Indian rupees a litre, whereas farmers will have to pay 3-4 times more for substitutes.
- Endosulfan still provides a cost-effective crop protection tool, especially in developing countries. Its availability could make a significant difference to the grower's profit or loss. It results in lower prices for the consumer and more profit for the farmer.
- Elimination of the generic pesticide endosulfan will directly promote the use of patented alternatives and benefits European multinationals. This has been the motivation for European multinationals to replace low priced generics with their expensive patented alternatives
- These high priced alternatives will directly benefit European Companies. By pushing for a ban on Endosulfan, EU is promoting the interest of European Trade.

Arguments on timing

- If the pesticide was dangerous, why did the EU use it for over 50 years?
- There were no issues over the use of endosulfan until 2001, when the sole European manufacturer decided to phase out the product from its portfolio.

The scientific background of the characteristics of endosulfan concerning persistence, bioaccumulation and toxicity (PBT) and its ability to be transported over long distances have already been explored in the risk profile (UNEP, 2009a) and the risk management options in the risk management evaluation (UNEP, 2010a). These subjects will not be further explored in depth in this report. Main attention in this report is addressed to the topics listed above. In doing so, considerable amount of data has been retrieved from the information submitted by the Parties to the Convention for annex E (UNEP, 2009b) and annex F of the Convention (UNEP, 2010b). The first chapters focus on production and producers of endosulfan and on worldwide use and supply. Further chapters are dedicated to export from the European Union, registration and application of endosulfan, its toxicity, the development in maximum residue levels (MRLs) and the alternatives. The report finally discusses the process of phase out of endosulfan.

Disclaimer: All the information in this report has been retrieved from the scientific literature, from annual reports, from governmental databases or from other open sources on the internet. The data retrieved have been critically analysed and if possible cross checks have been carried out. However, not of all the sources reliability could be established. Therefore, all data presented have been accompanied by their original source link.

2 Producers and production of endosulfan

Endosulfan is produced as technical endosulfan (94%) as flakes or crystals. The technical grade active ingredient can be processed into various formulations, either by the primary producers or by special formulating companies in the region of application. FAO (2011) distinguishes endosulfan as dustable powder, wettable powder, oil miscible liquid and emulsifiable concentrate. Emulsifiable concentrate and wettable powder seem to be the most widely used products. Amounts of the concentrates are often provided in million liters, whereas amounts of the technical product and the solids are often provided in metric tonnes or kilogrammes. The chapters on production, marketing and sales focus mainly on the technical product.

Endosulfan was placed on the market in the 1950's by Farbwerke Hoechst A.G. in Frankfurt, Germany (now Bayer) and FMC Corporation in the United States. It may be assumed that until the end of the 1970's endosulfan was only produced by these patent holders. The development codes for endosulfan Hoe 02 671 (Hoechst) and FMC 5462, still lead back to the original producers. After 1990 Hoechst merged several times and finally became a part of Bayer CropScience in 2002 (Table 1).

Table 1. The endosulfan producing companies in Europe in the last two decades. Producer is marked by an asterix (*). Modified after Khooharo (2008).

before 1994	1994	1999	2002
Bayer AG	Bayer AG	Bayer AG	Bayer CropScience *
Hoechst *	AgrEvo GmBh *	Aventis CropScience *	
Schering			
Rhône Poulenc	Rhône Poulenc		

In the 1980's Hoechst was still the major producer of endosulfan (ASTDR, 2000). Largest amount of endosulfan was produced in the EU until 2006, after which production in the EU ceased (Annex F information by India). "*Germany had produced and supplied nearly 50% of the worlds consumption of Endosulfan between 1955 and 2006*" (Golkeri, 2010). Bayer stopped its production at the beginning of 2007. Sales within the EU have stopped in 2007. Agrow (2009) reported that Bayer continued to supply some markets in order to meet local requirements within the agreed framework of the phase out. In those cases Bayer provided training programmes to ensure proper handling of endosulfan. Supply outside the EU has stopped in 2010 (Bayer, 2009). Until 2010 Bayer still sold endosulfan under the original brand name Thiodan.

Endosulfan was produced in the United States by FMC Corporation. ASTDR (2000) reports a production of two million pounds in 1971 and three million pounds in 1974, equivalent with 907 and 1361 metric tons respectively. However, also lower figures are provided. Endosulfan has not been produced in the United States since 1982 (ASTDR, 2000). FMC sold all EPA registrations and formulations of endosulfan in 2002 to the American branch of the Makhteshim Agan Group (MANA), but the brand name Thiodan was not included in the sale. Makhteshim introduced endosulfan under a new name Thionex.
Makhteshim produces endosulfan in Israel, but no information on the date of start of production nor on production volumes are available. In December 2010 Bloomberg Business Week reported Chemchina to buy a 60% controlling stake in Makhteshim-Agan, but that approval by the Makhteshim shareholders and

Chinese regulators would lead the deal to be completed later in 2011. The deal is also reported in the 2011 China Pesticide Suppliers Guide (Stanley Alliance Info-Tech Ltd, 2011). An earlier deal to buy the Australian pesticide producer Nufarm in 2009 failed (Reisch, 2010).

The risk management evaluation for endosulfan mentions production in Brazil (UNEP, 2010a). From the report it is not clear if this considers the primary production of endosulfan, or if endosulfan is only being formulated. The amount used within Brazil, based on data from 2000 until 2006, varies between 2500 and 7300 metric tonnes a year (Annex F Information). No data on production were available, nor could the producer be identified.

India imported endosulfan until 1980 and started with the production of endosulfan in 1976. Several sources mention Excel Crop Care Ltd, E.I.D. Parry (now Coromandel International Ltd) and Hindustan Insecticides Limited (H.I.L) as primary producers. This is confirmed by the annual reports of these companies. India reports that production takes place in three states: Gujarat, Kerala and Maharashtra states (UNEP, 2010b). The factories are situated in Bhavnagar, Gujarat (Excel Crop Care Ltd), Thane, Maharashtra (Coromandel International Ltd), and in Udyogamandal, Kerala (Hindustan Insecticides Ltd). The first two companies are private companies, Hindustan Insecticides Ltd is owned by the Indian Government and the production data are reported by the Indian Ministry of Chemicals & Fertilisers.
Monthly production data for endosulfan in India are provided on the website of the Analyst association, India, a company carrying out credit analysis. These data show a monthly endosulfan production between 1116 and 1681 tonnes from January until September 2010. Recalculation results in a production of almost 16.500 tonnes per year (Analyst Association, 2011). Data from the annual reports of the three firms enable estimates that are between 9,200 and 14,700 metric tonnes (see Annex 2). The higher volumes compared to the amount reported in the annex F information coincide with the decrease in shipments from Europe (see chapter 4).

China started producing endosulfan in 1994. In 2001 there were two producers and 36 formulators, whereas in 2005 there were three producers of technical endosulfan and 43 formulators. All three producers were located in the Jiangsu province in 2005 (Jia et al., 2011). Production in China took place in Aventis Tianjin, renamed AgrEvo Tianjin in 1996. Since 1999 the plant at Bejing started producing endosulfan (Dewar, 2003). In 2001 China still imported from Germany, Israel, South Korea and India as the Chinese production did not meet the needs. The present situation is unknown (Jia et al., 2011).

In the Republic of Korea endosulfan is being produced by Seo Han, a subsidiary company of the Nichimen Corporation. No data are available on the period of production and the amount produced.

There are no data for endosulfan available for the first decades of production. Production of endosulfan was in 1982 estimated to be 10,000 tonnes per year (ATSDR, 2000 citing WHO, 1984). For 2010 worldwide production of endosulfan was estimated to range between 18,000 and 20,000 tonnes per year (UNEP, 2010b). The German estimate in the annex F submission (UNEP, 2010) provides a rough estimation of 10,000 – 50,000 tonnes per year in Europe only. Saiyed et al. (2003) refers to a production of 81.600 tonnes during 1999 – 2000, but it is not clear if the production reflect production in both 1999 and 2000 and the original source can not be traced back.

Table 2. Overview of producers of technical endosulfan

country	producer	production period	present production volume (metric tonnes)	source
Germany	Bayer CropScience	1956-2007	0	chapter 1
United States	FMC Corporation	1956-1982	0	chapter 1
India	Excel Crop Care Ltd	1976 - present	4400-7300	annex I
India	Coromandel International Ltd	> 1976 - present	1900-3200	annex I
India	Hindustan Insecticides Limited (H.I.L)	> 1983 - present	2900-4200	annex I
Israel	Makhteshim Agan Int.	unknown	unknown	chapter 1
China	Aventis Tianjin	1996 - present	unknown	chapter 1
China	unknown	1999 - present	unknown	chapter 1
China	unknown	> 2001 - present	unknown	chapter 1
Rep. Korea	Seo Han	unknown	unknown	chapter 1
Brazil	unknown	unknown	unknown	chapter 1

Summarizing, production of endosulfan is limited to three companies in China, three in India, one in Korea, one in Israel and probably one in Brazil. Production in Europe and the United States has ceased. Data on production in Brazil, Israel and Korea were not available (Table 2). Production is estimated to be at least 20,000 metric tonnes of technical endosulfan and this amount has been used in all further estimations. India produces between 50 and 70% of the world market of endosulfan (Annex F information, AgroNews, 2011). Although the production sites will probably not change in the near future, the information on the companies shows that the playing field is changing rapidly. Agrow (2006) indicate that the pesticide market is shifting from a market with a few specialised companies into a market in which a diversity of companies that are producing a growing amount of off-patented generic pesticides.

3 Worldwide use and supply of endosulfan

Information on the import, export and sales of endosulfan was gathered from the annex F information delivered to the Secretariat of the Stockholm Convention (UNEP, 2010b), scientific publications, export and import data, registration data and sales offers. The export databases often mention the primary producers, sometimes a trading house, whereas in the registration databases often the formulations and the formulators are mentioned. However, it is important to realise that endosulfan is often exported as technical product (94% active ingredient), whereas it is being put on the market in various formulations. Most attention in this chapter is paid to the technical product.

3.1 Amounts of endosulfan used and suppliers

Use data are summarized in Table 3, which is mainly based on data provided for the annex F and limited data from other sources.
There is limited information on the amount of endosulfan applied relative to other pesticides. At present, endosulfan is among the 10 top selling pesticides in India (Stanley Alliance Info-Tech Ltd, 2010) and number two in weight of applied pesticides in Pakistan (Khoohora, 2008).

Table 3. Present use of endosulfan in nine selected countries for which data were available

country	use in Kg	data source
USA	400,000	annex F information
Brazil	5,144,000	annex F information average 2001-2006
Argentina	1,500,000	annex F information
Peru	107,000	annex F information average 2006-2008
Mexico	486,000	Ize Lema, 2010
China	4,100,000	annex F information
India	5,000,000	annex F information
Australia	105,000	annex F information average 2004-2007
Burkina Fasso	560,000	data PIC average 2006/07 -2007/08
total	17,402,000	

Endosulfan use in Europe varied in the 1990's approximately between 500 and 1000 metric tonnes (OSPAR, 2004). Bayer CropScience and Makhteshim Agan were the main suppliers. At the end of the 1990's the application of endosulfan was re-evaluated within Europe. In the 1999 Monograph of the EU, Hoechst Schering AgrEVO and Makhteshim Agan International, Calliope, S.A. and B.V. Luxan (a subsidiary of Excel Industries Limited) are mentioned as applicants for the re-evaluation. Luxan failed to deliver data on the methods of manufacture and further specifications and Calliope S.A. showed not to produce endosulfan by itself, but to retrieve endosulfan from Seo Han, Korea. Both companies were subsidiary companies of the Japanese Nichimen Corporation. In 2005 the EU decided not to incorporate endosulfan in the list of authorised plant protection products, annex I of directive 91/414/EC (2005/864/EC). As a result endosulfan has been phased out 2007.

Most up-to-date use data for the United States are from CropLife Foundation (2006) which only mentions Thionex with Makhteshim as registrant/manufacturer. Approximately 400 metric tonnes are used annually (Table 3). Data from Smith (2001) and Smith et al (2008) indicate that in the period 1997 to 2003 35-50 metric tonnes were shipped annually, mainly to Central and South America. The re-evaluation data from Health Canada (2009) show that main players in Canada are Bayer CropScience and Makhteshim Agan of North America Inc (Annex 3).

A large part of the world production of endosulfan ends up in South America. Argentina, Brazil, Mexico and Peru account for 7,200 metric tonnes (Table 3), which is 36% of the estimated world production of 20,000 metric tonnes. A UNEP report on chemicals in South America indicates that endosulfan was already imported in the 1970's in considerable amounts (UNEP, 2002). The data of Peru submitted for annex E of the Convention (see annex 4) and data from Mexico (Ize Lema, 2010) enable us to indicate from which country the endosulfan has been shipped and their relative amounts. For the other countries no quantitative data were available. The registration data and formulators for Mexico have been provided in annex 5.

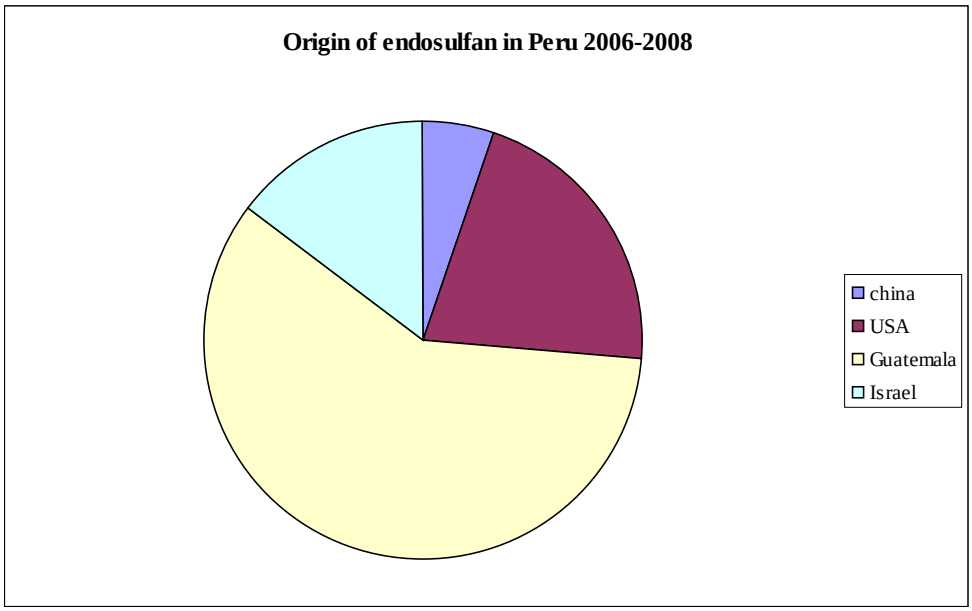

Figure 1. Origin of endosulfan marketed in Peru in the period 2006 – 2008. Total consumption in this period was 320 metric tonnes, equivalent with 107 tonnes per year.

Peru imports around 100 tonnes per year (Figure 1). Most of the endosulfan is imported from Guatemala, followed by the United States and China. The registration data for Peru (annex 4) indicate that the market is divided between Bayer, who imports the endosulfan from Guatemala (Westrade Guatemala S.A.), and various regional players who get there product either from Israel (Maktheshim), China (Sinochem Ningbo Chemicals Co Ltd and Nova Crop Protection Co Ltd) and the United States (Drexel Chemical Co). The amount imported from India was only 2 kg. Remarkable is also the last shipment where Bayer imported Thionex from Israel instead of putting its own product on the market.

The data from Mexico indicate that the endosulfan is imported from Germany, Israel and India (Figure 2). The relative contribution of the three countries varies over the years, although the amount imported from India seem to increase after 2006, whereas the contribution of Germany was reduced until zero in 2009. Total export from Mexico in the period 2005 to 2009 amounted 25.8 tonnes and could be divided between China (18.9 tonnes), Israel (3.9 tonnes) and Guatemala (3 tonnes) (Ize Lema, 2010).

Figure 2. Origin of endosulfan marketed in Mexico in the period 2003 – 2009. Total consumption in this period was 3400 metric tonnes, equivalent with 486 tonnes per year.

In Brazil around 1/4th of the world production of endosulfan is applied. A presentation from September 2010 by Anvisa (2010), the Brazilian National Health Surveillance Agency, shows that six technical formulations are registered in Brazil (Table 4). These will be the basis for formulating the commercial product. The data indicate that besides the Brazilian companies Servatis, Fersol, Milenia Agrociensias A.G. and Nortox, Makhteshim and three Indian companies are active. Remarkable is the absence of Chinese companies. The data do not allow giving a quantitative estimation of the origin of endosulfan. Several registration holders get their technical endosulfan from different producers. The data also show various Brazilian producers of endosulfan, but does not allow identifying the location(s) of production. At present, main players in Brazil considering the commercial formulations are Bayer, DVA GmbH, Milenia Agrociensias A.G. (a subsidiary of Makhteshim-Agan), Nufarm (joint venture with Excel) and Nortox, a Brazilian company (Hirata, 2010).

Table 4. Registration holders for technical endosulfan in Brazil and the original producers

Commercial product	Registration holder	Producer
Endosulfan Técnico Agripec	NufarmIndústria Química e Farmacêutica S.A.	Coromandel Fertilisers Limited. – Thane - Índia Servatis S.A. - Brasil
Endosulfan Técnico DVA Agro	DVA Agro do Brasil – Comércio, Importação e Exportação de Insumos Agropecuários LTDA.	Fersol Indústria e Comércio S.A - Brasil Servatis S.A. - Brasil
Endosulfan Técnico Milênia	MILENIA AGROCIÊNCIAS S.A. – Londrina	Makhteshim Chemical Works Ltd - Israel
Endosulfan Técnico Milenia BR	MILENIA AGROCIÊNCIAS S.A. – Londrina	MILENIA AGROCIÊNCIAS S.A. – Brasil
Endosulfan Técnico Nortox	NORTOX	NORTOX S.A. – Brasil Hindustan Insecticides Limited – Índia Excel Crop Care Limited – Índia
Endosulfan Técnico 930 BR	MILENIA AGROCIÊNCIAS S.A. – Londrina	MILENIA AGROCIÊNCIAS S.A. – Brasil Makhteshim Chemical Works Ltd – Israel

Australia uses a limited amount of endosulfan compared to other agricultural countries, about 100 metric tonnes (Table 3). The data from Australia (Annexes 6 and 7) show that besides Bayer CropScience, Excel Industries is active. It seems that Makhteshim, who was an approved source of endosulfan in 1999, is not active on the Australian market any more. The amount applied has decreased significantly since the 1990's due to the introduction of Bt cotton and restrictions within Australia (APVMA, 2005, Cuddy, 2010). The amount has also decreased in New Zealand during the last 10 years (New Zealand Government, 2011).

Data on endosulfan use from Asian and African countries are limited. For most countries the annex F information from UNEP does not allow to draw conclusions on the origin of the endosulfan marketed and the amounts.
It can be expected that the Indian producers produce largest amount of the 5000 metric tonnes used in India annually. There is no information on the market shares. From various sources it is clear that both Bayer and Maktheshim are active on the Indian market, but mainly as formulator (see annex 2).
Jia et al (2011) estimates the total use of endosulfan in China to be around 25,700 metric tonnes between 1994 and 2004, which is lower than the present amount of 4,100 metric tonnes per year (Table 3). The same article show an increase of endosulfan used in China during that period, with around 3,000 tonnes after 1997, which is in line with the 4,100 tonnes reported in the annex F report (Table 3). Although there are no data on the suppliers within China it may be assumed that the three Chinese producers have a relatively large market share.
Registration data show that companies which place endosulfan on the market vary from country to country (see annexes 3, 4, 5, 6, 7). It is not always clear who the primary producer is. However, the available data suggest that Bayer, Maktheshim and the Indian companies are much more active on the world market than the Chinese companies.

3.2 Amounts of endosulfan exported

Some export data from India could be retrieved from the internet (Annexes 8 and 9). The two selections retrieved (both period September 2003 – October

2004) show some overlap which enables us to estimate a total amount exported. Yearly exports for 2003/2004 were estimated to be between 3500 and 7000 tonnes as a minimum. The data presented in annex 8 indicate that more than 757 metric tonnes were exported to 26 different countries between September 2003 and October 2004 (Figure 3). More than 10% were exported to Brazil (10.5%), Iran (13.0%) and Thailand (10.2%). Countries to which more than 5% was exported were Argentina (6.2%), Israel (5.3%), Nigeria (5.6%), Uruguay (6.2%) and the Democratic republic of Vietnam (9.2%). The 757 metric tonnes is thought to represent 1/10th of the total Indian export of endosulfan in 2003/2004, assuming a minimum export of 7000 metric tonnes.

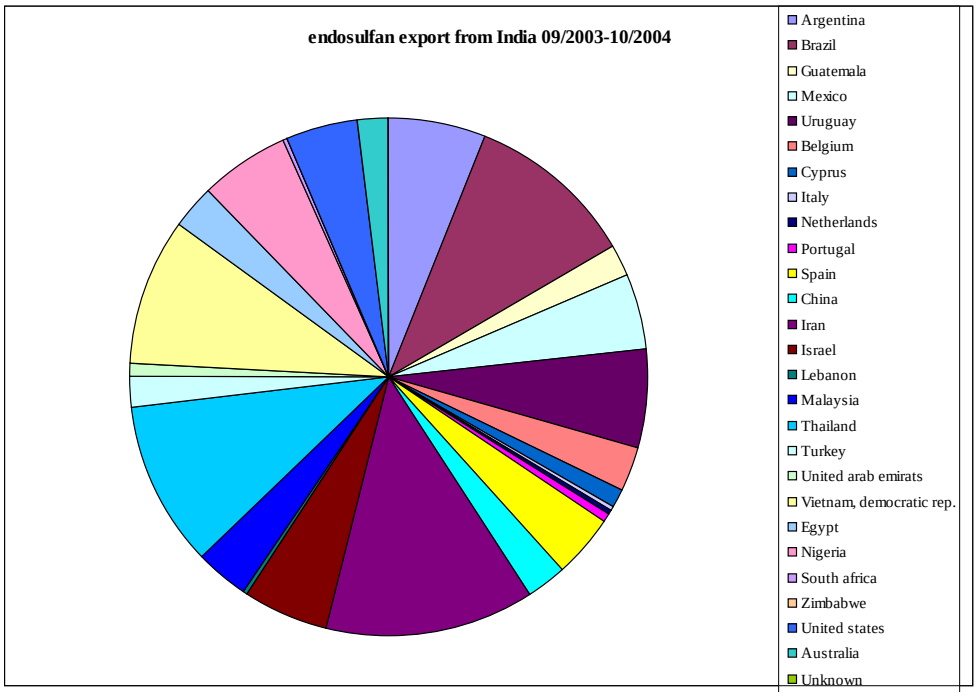

Figure 3. Export of endosulfan from India to other countries for the period September 2003 – October 2004. For data see annex 8.

3.3 Total amounts of endosulfan produced and market value

Data on use, export and import do enable to estimate the total marketed volume. Data on the Indian producers suggest a production of between 9,200 and 14,700 metric tonnes (annex 2). India uses nationally 5000 metric tonnes according to the annex F information and export is thought to be at least 7000 metric tonnes. It may further be assumed that China is self supporting and also exports some amount. Furthermore, considerable amounts of endosulfan in South America are imported from Israel. Based on import and use data in annex F, the Rotterdam Convention and other data sources a total amount of almost 17.500 tonnes of active ingredient can be estimated for nine countries (Table 3). As there are at least 40 countries that use endosulfan, this suggests that the estimated production of 18,000 – 20,000 metric tonnes estimated in the risk management evaluation (UNEP, 2010a) is too low.

The export data from India (Figure 3), the data on approved sources of Australia (annex 6 and 7), the import data from Peru (Figure 1) and the registration data (annexes 3-7) show that the sales of endosulfan is a global market. Some of the retrieved data enable us to estimate the annual worldwide sales assuming a

market of 20,000 metric tonnes. In 2000 to 2001 Colombia imported 265.750 kg endosulfan against a price of 2,604,866 US $ (UNEP, 2010b). Assuming a world wide production of 20,000 metric tonnes this would represent about 200 million US $. The latest data from Bayer CropScience Ltd India (see annex 2) enables to estimate a metric tonne price of 4702 US $. This would result in a total price of about 94 million US $ for the world market. This range fits quite well into the data provided by Agrow (2006), which rank endosulfan in the top 10 most popular generic pesticides worldwide. However Agrow (2006) does not rank endosulfan in the top 12 pesticides with the highest market value, indicating that this is less than 280 million US $.

On an Indian website it was stated that the worldwide usage of endosulfan formulation was 40 million litres, equivalent with 300 million US $. India produces between 50% to 70% of the world wide market for endosulfan (Annex F information, UNEP, 2010b). The Indian production has a market value of about 100 million US $ according to Lakhsmi (2011). In Brazil about 20 million litres of the formulation 35% EC was sold in 2009 (Hirata, 2010). Although there are some data gaps, the statements made make clear that endosulfan is important for the Indian economy. At present, endosulfan is still among the 10 top selling pesticides in India (Stanley Alliance Info-Tech Ltd, 2010). Narula & Upadhyay (2010) indicate that endosulfan generates more than 50% of the revenues of Excel Crop Care Ltd. The other two Indian producers are less dependent on endosulfan (see also annex 2).

Concluding, the market for endosulfan is divided among a few big companies and a large amount of smaller companies that make formulations. Main players may either act as primary producer, or as formulator. Most producers are at present located in South and South-East Asia. Export data show that these companies market endosulfan to a range of countries world-wide. Based on export and import data the amount of 18,000 – 20,000 world wide production estimated earlier is thought to be too low. India accounts for a 50% to 70% of the world wide endosulfan production (Annex F information, UNEP, 2010a). The market is valued at least 200 million US $.

4 Export from the European Union

During the process of nomination of endosulfan for listing within the Stockholm Convention there were remarks that the European Union nominated endosulfan, but still exports it. Similar objections were formally raised during the nomination process of endosulfan for the Rotterdam Convention (or Prior Informed Consent Convention) (UNEP, 2010c). That was reason to explore these objections, and, if exports still take place, to explore if exports could be prevented by existing European legislation. However, first the nomination process of endosulfan within the Rotterdam Convention is described.

4.1 Endosulfan within the Rotterdam Convention

The Rotterdam Convention, which was adopted in 1998, aims to minimise the trade of hazardous substances (Rotterdam Convention, 2011). Under the Convention a Party shall notify the Secretariat of the Convention that it has adopted a final regulatory action to ban or severely restrict a chemical. After receiving two nominations from two different PIC regions, the Secretariat of the Convention shall forward them to the Chemical Review Committee (CRC). After reviewing the information in the notifications against the criteria set out in the Convention, the CRC recommend to the Conference of Parties whether chemical should be made subject to the PIC procedure and listed in Annex III of the Convention. Endosulfan is a candidate chemical to be included in the Rotterdam Convention on Prior Informed Consent.

In 2004 three notifications from three regions were received by the 1st meeting of the Chemical Review Committee (CRC) that met the information requirements of Annex I relating to endosulfan. The notifications were from Near East – Jordan; Europe – the Netherlands and Norway; and Africa – Côte d'Ivoire. For CRC-2 supporting documents were delivered by Netherlands and Thailand. Further supporting documents were delivered by the European Community and Burkina Faso, Cape Verde, Gambia, Mali, Mauritania, Niger and Senegal for the 4th Conference of Parties (COP-4) in 2007.
http://www.pic.int/home.php?type=t&id=238&sid=75
At present the CRC has considered notifications to ban or severely restrict endosulfan from Burkina Faso, Cape Verde, Côte d'Ivoire, Gambia, Guinea Bissau, Iran (Islamic Republic of), Jordan, Malaysia, Mali, Mauritania, Netherlands, New Zealand, Niger, Norway, Senegal and Thailand, and the European Union. The received notifications have been summarized in annex 10.

The inclusion of endosulfan, as recommended by the CRC at its second meeting, will be discussed at the next Conference of Parties (COP5), which will take place in June 2011. The recommendation was based on the notifications of final regulatory action from the Netherlands and Thailand discussed on CRC2 in 2004 and has been discussed in the COP before. However, listing has been reissued for technical reasons[1]. The technical reasons are not further clarified on the Conventions website.

[1] The webpage of the Rotterdam convention state: UNEP/FAO/RC/COP.5/12 - Inclusion of endosulfan in Annex III to the Rotterdam Convention, as recommended by the Chemical Review Committee at its second meeting following notifications of final regulatory action from the Netherlands and Thailand (reissued for technical reasons); http://www.pic.int/home.php?type=b&id=171&sid=27&tid=41

Before the Convention came into force in 1998 there was already a UNEP/FAO prior informed consent procedure in operation since 1989 (Smith & Root, 1999, Roberts et al., 2003, website Rotterdam Convention, 2011). In that period inclusion of endosulfan has at least been discussed as Hoechst has sent a letter entitled “comments on the nomination of Endosulfan to be included in the Prior Informed Consent Procedure” on 19 February 1991. The contents of the letter can not be further clarified as only the reference could be traced back and not the letter itself.

4.2 European legislation and the export of endosulfan

The European Union has already listed Endosulfan in Annex I to Regulation (EC) No 689/2008, which lists chemicals subject to the European export notification procedure. The regulation requires a Member state that plans to export a chemical that is banned or severely restricted for use, must inform the importing country that such export will take place, before the first shipment. The notifications are stored in the so called EDEXIM (European Database Export Import of Dangerous Chemicals) databank. The export data for endosulfan from EDEXIM for 2008-2010 (Edexim, 2011) are given in Table 5.

Table 5. Export, as number of shipments from Europe to other countries, retrieved from EDEXIM.

Export of endosulfan from Europe				
year		2008	2009	2010
from	to	no. of shipments	no. of shipments	no. of shipments
Germany	Turkey	1	1	
	Brazil	1	1	
	China	1		
	Pakistan	1		
	Republic of Korea	1		
	Australia	1		
	Argentina	1		
	South Afrika	1		
	Switzerland	1		
	Canada	1		
	Colombia	1		
	Guatemala	1		
	Mexico	1		
	Islamic Republic of Iran	1		
France	Morocco	1	1	1
	Sudan	1	2	1
	Macedonia	1		
	Bolivia		1	
Spain	Dominican Republic	1	1	1
	Morocco	1		
	Switzerland	1		
	Algeria	1		

For 2011 EDIXIM contains three notifications with exports of endosulfan + dimethoate from France to Sudan, endosulfan from France to Sudan and endosulfan 35% from Spain to the Dominican Republic. The data from EDEXIM show that there are still exports from Europe to other countries. However, the number of shipments is decreasing. The data do not allow giving any indication on the amount shipped. Equivalent with the Rotterdam Convention, the European regulation does not prohibit export.

The pesticide market is a worldwide market with a lot of private companies being active (Agrow, 2006, export data annex 8). These companies may produce and market pesticides if not explicitly prohibited. Within Europe the sales of pesticides is regulated by directive 91/414/EEC which focus on marketing and use of pesticides within Europe. Production of chemicals is regulated by the REACH regulation, but this regulation focuses on industrial chemicals and excludes, among others, pesticides. Thus production within the EU and trade of endosulfan is still possible. This situation is comparable to that in the USA where US non-registered pesticides can still be produced and exported (Smith & Root, 1999, Holley, 2001) or to India which has similar provisions (Indian Pesticide Registration Board, 2011).
The only legislation where the production and sales of pesticides is regulated is the EU POP Regulation ((EC) 850/2004), which is the European implementation of the Stockholm Convention. Examples of pesticides of which production, marketing and use are forbidden through the Stockholm Convention are the drins and heptachlor. Listing of endosulfan in the annexes to the Stockholm Convention would thus be the correct instrument to also prevent production, trade and use of endosulfan, unless a large amount of exemptions are granted.

5 Registration and application of endosulfan

The information on the registration and use of endosulfan in different countries is based on the UNEP annex F information, on the UNECE Risk Management Evaluation on endosulfan (UNECE, 2010), reports for the Rotterdam Convention and national registration databases.

5.1 Registration, restriction and formulations

At present endosulfan is registered or in use in 40 countries including Argentina, Brazil, Canada, China, India, and the United States. Of these countries Australia, Brazil, Canada and United States will phase out endosulfan in 2012, 2013, 2016 and 2016 respectively. Furthermore, Argentina officially notified a phase out in 2012, and Japan and Korea announced a phase out at POPRC5. Registration within Japan is not prolonged since September 2010 and Korea will phase out endosulfan at the end of 2011. Endosulfan is prohibited in 70 countries, including the EU-27. No information is available for the remaining countries. A complete overview is provided in annex 11.
Registration varies considerably. Some countries have registered only a few commercial products containing endosulfan, other countries have registered dozens of commercial products from various formulators, e.g. Argentina have registered 53 commercial products (see annex 12), Mexico 84 (Ize Lema, 2010).

Generally, the use of pesticides have stabilized or declined in developed countries, but increased rapidly in developing countries. Most of the pesticides in developing countries are off patent pesticides (Sosan and Akingbohungbe, 2009). This trend for endosulfan can be clearly illustrated with data from the US (Table 6) and Europe (Table 7). In Europe endosulfan was phased out in 2007 after a decline since 1990. A similar decline can be observed from the US data. In the United States endosulfan will be phased out in 2016. Data from Central and South America (UNEP, 2002, Table 3) suggest that use of endosulfan has increased considerably during the last two decades.

Table 6. Use of endosulfan in the USA between 1992 - 2008 (metric tonnes). Source: CropLife Foundation (2006) and annex F (UNEP, 2010b)

active ingredient	1992	1997	2002	2006/08
Endosulfan	815,0	726,3	393,7	181,4

Table 7. Endosulfan use in Europe between 1994 and 1999 (metric tonnes). Later data were not available. Source: Ospar, 2004.

	1994	1995	1996	1997	1998	1999
Northern Europe	294,4	406,2	394,7	67,8	42,6	38,1
Southern Europe	542,2	621,8	566,3	522,9	485,5	431,2
total Europe	836,6	1028	961	590,7	523,1	469,3

Information on the registration and use in various countries has been summarized by the United Nations for their work within the Rotterdam Convention (United Nations, 2002, 2009). The summary provides a good insight in the status of endosulfan in various countries and is reflected in annex 13. Several countries have registered endosulfan, but indicated that they have severely restricted the application, for instance Belize, Costa Rica, the Philippines, the Republic of Korea and Thailand. Other countries first restricted

the use of endosulfan before it was totally banned (e.g. Kuwait (restrictions already in 1993), the Netherlands (phase out in 1991) and Serbia (phase out in 2009). The data show that quite some countries took already measures regarding endosulfan in the 1980's and 1990's (United Nations, 2002, 2009).

In Costa Rica, endosulfan has a restricted use and must be accompanied by a professional prescription. For rice production it is prohibited and it is only permitted for use in agriculture in liquid or microencapsulated formulations with concentrations less than or equal to 35% of active ingredients (Annex F submission, Costa Rica). The Annex E information of Honduras showed that endosulfan cannot be used in crops by flood such as rice. Thailand severely restricted the use of endosulfan. Thailand registered the use of capsulate formulation, while banning emulsifiable concentrate and granular formulations. Thailand based this decision on a national risk evaluation where it was shown that the use of endosulfan for the golden apple snail lead to death of fish and other aquatic organisms. According to Carvalho et al (2009) endosulfan was commonly used in rice fields in the Philippines before it was banned in 1993. Quijano (2000) describes the efforts taken by the Philippines Fertilizer and Pesticide Authority in the early 1990's to ban endosulfan based on the pesticide-related poisoning cases. At present endosulfan is only allowed in pineapple plantations. Within the European Union only agricultural uses were allowed and non-agricultural ones had ceased in 2004 (OSPAR, 2004). The Australian Pesticides & Veterinary Medicines Authority (APVMA, 2005) provided a number of possible regulatory and management options in their evaluation report. Measures already taken before 2005 included declaring endosulfan products to be restricted chemical products, requiring users to undertake specified training and restricting the number of applications per season. The examples provided here and in annex 13 refute remarks as if measures should have only been initiated by the European phase out of endosulfan.

The encapsulated formulation of endosulfan has also been applied in some other countries. Mexico has registered the application of micro-encapsulated endosulfan in safflower. The registration is for Thiodan ultracaps, which suggest that it is being supplied by Makhteshim. The encapsulated formulation was also used in cotton in 1998 in Cote d'Ivoire, Benin, Burkino Faso, Togo and Mali after endosulfan had not been used since 1980 (Martin et al., 2005).
Mirco-encapsulation is rather a new phenomenon. First patents on micro-encapsulation date back to the 1980's. They were developed for pyrethroids because of their high fish toxicity limit application in crops grown in or near water. Specifically rice is mentioned in the patent [patent number EP0183999A1]. Patents on the encapsulation of endosulfan date from the period after 1995 and can be related to the US company Micro Flo [patent number CA2148342 issued 1995], Aventis CropScience [patent number US6294570, granted 2001] and the Ben Gurion University, Israel [patent number EP0748158B1, granted 2003][2]. Although the encapsulation does not take away the persistent and bioaccumulative properties of endosulfan it regulates exposure and thus may modify maximum concentrations in the surrounding medium. Roy et al (2009) use the term "controlled release" which refer to the ability to release the pesticide at a desired controlled rate over an extended

[2] Patents available at: http://www.patsnap.com/patents/view/US6294570.html http://www.wikipatents.com/CA-Patent-2148342/encapsulation-with-water-soluble-polymer

period of time. Martin et al (2005) describe that the micro-encapsulated formulation was used in Cote d'Ivoire, Benin, Burkino Faso, Togo and Mali in order to limit the environmental and health problems linked with endosulfan. For the same reason experiments with calcium alginate gelatine microspheres loaded with endosulfan were carried out at the Department of Chemistry Government Autonomous Science College in Jabalpur, India (Roy et al, 2009).

Endosulfan has been banned in the EU since 2007 after a gradual decline since 1990 (annexes 14 and 15). As indicated in the annex F information submitted by Romania (UNEP, 2010b) the EU Pesticide directive allows derogations under special circumstances. An EU Member State may authorise for a period not exceeding 120 days the placing of endosulfan on the market for a limited and controlled use. Annex F states: "*In 2009 a derogation for use as rodenticide for the rape, orchards, stalky cereals crops (harmful organisms – Microtus arvalis) was granted by the Ministry of Agriculture - National Phytosanitary Agency, for a quantity of 16620.8 kg endosulfan (included into 47488kg/44800 litres THIONEX 35EC), in accordance with the provisions of Article 8 (4) of Council Directive 91/414/EEC of 15 July 1991 concerning the placing of plant products on the market*" In 2009 Italy got a derogation for use of endosulfan as insecticide for hazelnut (harmful organism – *Curculio nucum*) was granted.

5.2 Type of crops and amounts used

Considerable information on the use of endosulfan can be found in the compiled annex F information (UNEP, 2010b). This information has been summarized in Figure 4 and Table 8 and has been complemented with other data. Endosulfan is used in more than 100 crops. For most crops endosulfan is only registered in one (100) or two countries (21), which raise the questions about the necessity to use endosulfan for these crops.

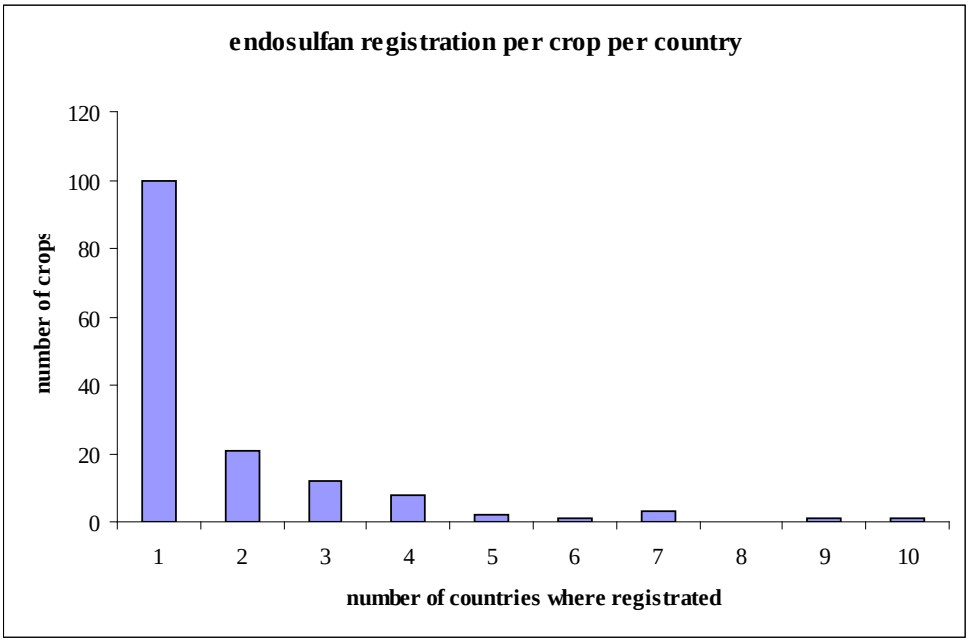

Figure 4. Frequency of the number of crops registered in 1 or more countries. For 100 crops endosulfan is only registered in 1 out of 19 countries.
Endosulfan is registered for the use on cotton in all 19 countries studied (not incorporated in Figure 5). Crops which are registered in more than 25% of the

countries are maize (10 countries), beans (9 countries, tomato and tobacco (7 countries), potatoes (6 countries), and apples and ‘vegetables’ (5 countries). Registrations in four different countries were found for broccoli, cabbage, cauliflower, citrus, coffee, onion, pear and wheat. The description of the crops is sometimes broad (pulses, beans, cereals, corn, cucurbits) and sometimes very detailed (Cape gooseberry, Mung beans, Navy beans), which makes comparison between the countries difficult. The importance of endosulfan for certain crops also depends on the geographical and climatic conditions. Argentina mentions soybean, sunflower and cotton as the main crops of application, whereas Brazil uses endosulfan in cocoa, cotton, coffee, soybean and sugar cane. Both countries will phase out endosulfan in the next years.

Besides the application on crops Brazil report the application in soil, the application to control ant pests and the use of wood protector for e.g. railway sleepers, posts and other applications. United States reports the use in ear tags. A statement on the website of the New Zealand Government (2011) reflects on the use of endosulfan *“Endosulfan was not routinely used on crops but was used mainly as a back-stop when other pest control options did not work. Endosulfan was the only effective control against one or two crop pests found here. Most use occurred in outdoor vegetable production, largely potatoes. Citrus and berry fruit crops were the other main uses and it was also used ‘off label’ on turf for controlling earthworms.”*

Table 8. Application of endosulfan in various crops

country	China	India	Pakistan	Israel	Australia	Ethiopia	Ghana	Guinee	Mozambique	Nigeria	South Africa	Sudan	Uganda	Zambia	Argentina	Brazil	Mexico	Peru	USA
source	1	2	F	3	4	F	F	F	F	F	5	F	F	F	F	6	7	E	8
crop type																			
Advocados				x	x														
Adzuki beans					x														
Afforestation											x								
afforestation pine											x								
Alfalfa				x											x		x		
Almond				x															o
Apple	x			x							x						x		o
Apples & pears											x								
Apricot											x								o
Artichoke				x															
Asclepias				x															
Aster				x															
Barley																	x		
Beans				x		x		x	x	x	x		x	x			x		
Bean (dry)																			o
Beetroot					x														
Blueberry																			o
Boysenberries & Youngberries											x								
Brassica				x															
Broccoli					x						x						x		x
Brussels sprouts											x						x		o
Cabbage					x						x						x		o
Cacoa																x			
Cahabacano																	x		
Canola					x														
Cantaloupe																			x
Cape gooseberry					x														
Capsicum					x														
Carrots					x														o
Cashew					x														
Cauliflower					x						x						x		o
Celery					x												x		o
Cereals					x	x									x				
Cherries											x								
Chickpeas					x														
chile																	x		
Chillies		x																	
Citrus	x				x						x								o
Coffee											x					x	x	x	
Collard greens																			o
Cowpeas					x	x		x	x	x			x	x					
Cotton	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cruciferae											x								
Cucumber																	x		o
Cucurbits					x						x								
Custard apple					x														
Eggplant (Brinjal)		x			x												x		x
Lentil (Gram)		x																	
Faba beans					x														
Field peas					x														
Filbert																			o
Flax															x				
Flowers															x				
Flowers & ornamentals											x								
Fodder beet				x															
Granadillas											x								
Grapes											x								
Grapes (wine)											x								
Grass																	x		
Groundnuts		x									x								
Guavas					x														
Hops											x								
Horticulture crops									x										
Jute		x																	
Kidney beans											x								
Kiwi fruit					x														
Kohlrabi																	x		o
Lettuce																	x		o
Lemon																		x	
Linseed					x														
Longans					x														
Loquats					x														
Lupins					x														
Macademia nuts					x						x								o
Maize		x				x		x	x	x	x		x	x	x		x		
Mammey apples					x														
Mandarine																		x	
Mangoes					x														
Melon																	x		
Mung beans					x														
Mustard		x																	
Mustard greens																			o
Native trees					x														
Navy beans					x														
Nectarine																			o
Nursery crops					x														
Oilseeds						x													
Okra (Bhindi)		x			x														
Onion		x		x							x							x	

country	China	India	Pakistan	Israel	Australia	Ethiopia	Ghana	Guinee	Mozambique	Nigeria	South Africa	Sudan	Uganda	Zambia	Argentina	Brazil	Mexico	Peru	USA
source	1	2	F	3	4	F	F	F	F	F	5	F	F	F	F	6	7	E	8
crop type																			
Ornamental plants					x												x		
Ornamental trees, shrubs, hebaceous plants																			o
Paddy		x																	
Paprika											x								
Passsion fruit					x														
Pawpaw					x														
Pea											x						x		
Pea (dry)																			o
Peach											x						x		
Peanut = groundnut															x				
Pear	(x)										x						x		x
Pecan nuts					x												x		
Peppers																			o
Persimon					x														
Pigeon peas					x														
Pineapple											x						x		o
Pistachios					x														
Plum											x						x		o
Pome fruit					x										x				
Pomegranates					x														
Poplars																			o
Potato = papa		x			x						x						x	x	x
Proteas					x														
Prune																			o
Pulses						x													
Pumpkin																	x		x
Quinces											x								
Red gram (pulse) (Ahrar)		x																	
Safflower					x												x		
Sapodillas					x														
Shrubs					x														
Sorghum											x				x				
sorghum (grains)											x								
Soya beans					x										x	x			
Stone fruits not listed in Group A, including Nec																			o
Strawberry																	x		o
Sugar cane											x					x	x		
Summer melons (cantaloupe, honeydew, watermelon)																			o
Summer squash																			o
Sunflower					x										x				
Sweet corn											x								o
Sweet potato					x	x													x
Tamarillos					x														
Taro					x														
Tart cherry																			o
Tea	x	x														x			
Tobacco	x				x						x				x		x	x	o
Tomato					x			x		x	x		x				x		x
Mexican husk tomato (Physalis ixocarpa)																	x		
Turnip																	x		o
Various crops											x								
Vegetables						x		x		x			x		x				
Vegetable crops for seed (alfalfa, broccoli, Brus																			o
Vine																	x		
Walnut																			o
Watermelon																	x		
Wheat	x	x									x						x		
Wild flowers					x														
Winter squash																			o
Zucchini																	x		
number of crops	7	15	1	12	58	9	1	6	5	6	43	1	6	4	13	6	40	6	46

E = annex E submission (UNEP, 2009b)

F= annex F submission (UNEP, 2010b and 2010d)

1. China: x = annex F submission o= Jia et al. 2011, source Pesticide electronic handbook, 2006

2. India: Government of India, Ministry of Agriculture, Department of Agriculture & Cooperation, Directorate of Plant Protection, Quarantine & Storage. Central Insecticide Board & Registration Committee. N.H. IV, Faridabad-121 001. Major use of Pesticides registered under the Insecticides Act, 1968 2009. India's annex F submission mentions most of these crops except for maize, mustard, red gram and wheat.

3. Israel: registration database:
http://www.cinadco.moag.gov.il/ppis/english/search/NoKotelForm.asp
4. Australia: APVMA, 2005; the 2010 evaluation by Australia list 4 additional crops
5. South Africa: registration data South Africa
6. Brazil: Hirata, 2010
7. Mexico: http://www.cofepris.gob.mx/wb/cfp/catalogo_de_plaguicidas
8. USA: x = annex F submission, o = phase out schedule at:
http://www.epa.gov/pesticides/reregistration/endosulfan/endosulfan-crop-uses.html

The number of registrations and the application rates vary among crops, among pests and among countries. The number of registrations per crop for South Africa has been provided as an example (Table 9). Quite a number of application rates have been provided in the evaluations by the Joint Meeting of the FAO Committee on Pesticides in Agriculture and the WHO Expert Committee on Pesticide Residues (JMPR). The FAO report on endosulfan (FAO, 1993) provides a range of application rates for various crops in various countries, including the countries in which endosulfan is now prohibited. Application rates generally vary between 0.5 and 3 kg active ingredient per hectare. Extreme values reported are 14 kg a.i. per hectare (mushrooms, Belgium) and 0.075 kg a.i. per hectare (eggplant, Greece). Application rates are also provided in the annex F documentation (FAO, 1993) and can sometimes be found in the registration databases, see for instance the registration for India (annex 16).

Table 9. Number of registered products per crop type in South Africa

crop	no products	crop	no products
afforestation	1	groundnuts	11
afforestation pine	4	hops	2
apples	10	macademia nuts	6
apples & pears	10	maize	16
apricot	6	maize (sweet corn)	4
beans	17	onions	13
beans (kidney)	1	paprika	2
boysenberries & youngberries	4	peaches	15
brocolli	1	pears	10
brussels sprouts	1	peas	17
cabbage	1	pineapples	1
cauliflower	1	plums	14
cherries	8	potatoes	4
citrus	12	quinces	8
coffee	16	sorghum	11
cotton	20	sorghum	6
cruciferae	8	sugar cane	2
cucurbits	11	tobacco	11
flowers and ornamentals	21	tomatoes	11
granadillas	1	various crops	7
grapes	10	wheat	9
grapes (wine)	1		

Data on the total amounts used per crop is limited available. The US-EPA (2002) provides some use data for a large amount of crops in the United States. Table 10 provides the data for the crops to which an amount higher than 23 metric tonnes was applied or crops for which the percentage of crop treated with endosulfan was higher than 19%. Endosulfan was most applied to cotton, white potatoes and apples in the period 1990 to 1999. Furthermore endosulfan showed to be important for cantaloupes, eggplants, sweet potatoes, and squash considering the percentage of crop treated.

Table 10. Estimated endosulfan use in the United States between 1990 and 1999

Crop	A.I. Applied (wghtd avg. in metric tonnes)	Percent Crop Treated (Weighted avg.)	Percent Crop Treated (Likely max)
Apples	50	13%	20%
Cantaloupes	18	31%	57%
Eggplant	1	41%	83%
Lettuce	26	14%	31%
Pears	16	20%	48%
Pecans	27	11%	18%
Potatoes, White	54	10%	16%
Potatoes, Sweet	9	31%	46%
Pumpkins	5	20%	30%
Squash	20	40%	84%
Cotton	130	2%	4%
Tobacco	29	8%	12%
Horticultural Nurseries Stock	23	not available	not available

Endosulfan is applied on various crops to combat various pests. Endosulfan is registered for at least 110 crops (Table 8). Crops for which most authorisations are provided are cotton, cowpea (mainly in Africa), maize (corn) and tomato. Composite crop types such as pulses (beans and peas), and cereals (barley, paddy or rice, sorghum and wheat) have been registered as well in a number of countries, which makes comparison difficult. Nationally other crops may be of importance, such as coffee and tea.
It is expected that worldwide a high percentage of the endosulfan is applied on cotton. Firstly, endosulfan is registered for application on cotton for all countries listed in Table 8. Secondly, data from the United States on the amount of endosulfan applied on various crops during the period 1990 – 1999 showed that by far highest amount was applied on cotton. This is confirmed by data for Pakistan (Khooharo, 2008) and Australia. In the Australian re-evaluation of endosulfan it is stated that 70% of the nationally used endosulfan is applied to cotton (AVMPA, 2005). A market analysis on various crops indicate that, outside the United States, China, India and Pakistan combined are expected to account for more than 70 percent of total foreign production of cotton in 2009-10 (Anonymous, 2010).

6 Toxicity of endosulfan

In a considerable number of statements the toxicity of endosulfan has been disputed and it was also suggested that the first 50 years no action was taken to restrict the use of endosulfan. This was reason to explore the amount of publications available on the toxicity during time.

As the name already indicates pesticides are made to get rid of pests, and thus these substances need to be toxic. Most old pesticides were broad spectrum pesticides, which mean that they were toxic for a broad range of organisms. Endosulfan also fits into this picture. It is especially the high toxicity which causes problems on the short term.

6.1 Toxicity in general

The IPCS-INCHEM (International Programme on Chemical Safety) website provides a good overview of the publications FAO and WHO have been published on endosulfan from 1960 onwards (www.inchem.org/). The first reports on endosulfan were published in the 1960's less than 10 years after its introduction. These documents are still concise in size and the number of references is relatively limited. In 1984 the WHO Environmental Health Criteria 40 was dedicated to endosulfan. Larger evaluations appeared in 1998 and 2000 when the Toxicological evaluation and the Monograph were published. These reports contain a large number of publications from the late 1970's and the early 1980's. Whereas the first publications focussed mainly on food safety and the development of MRLs, later ones focus more on the environment and the characteristics of endosulfan (Table 11).

Table 11. Publications on endosulfan by FAO/WHO since 1965.

year	publication
1965	Endosulfan (FAO Meeting Report PL/1965/10/1)
1967	Endosulfan (FAO/PL:1967/M/11/1)
1968	Endosulfan (FAO/PL:1968/M/9/1)
1972	Endosulfan (WHO Pesticide Residues Series 1)
1974	Endosulfan (WHO Pesticide Residues Series 4)
1975	Endosulfan (PDS)
1975	Endosulfan (WHO Pesticide Residues Series 5)
1982	Endosulfan (Pesticide residues in food: 1982 evaluations)
1984	Endosulfan (EHC 40, 1984)
1988	Endosulfan (HSG 17, 1988)
1989	Endosulfan (Pesticide residues in food: 1989 evaluations Part II Toxicology)
1998	Endosulfan (JMPR Evaluations 1998 Part II Toxicological)
2000	Endosulfan (PIM 576) = Monograph
2001	ENDOSULFAN (MIXED ISOMERS) (ICSC)

The number of scientific publications in the open literature was investigated by a search in the SCOPUS database with the search terms "toxicity" and "endosulfan" for the period 1965 to 2011. The first scientific publications on endosulfan and toxicity in the open literature were published around 1970, about 15 years after its introduction on the market. The number of publications was below 10 per year until 1990. After 1990 the number of publications increased rapidly (Figure 5).

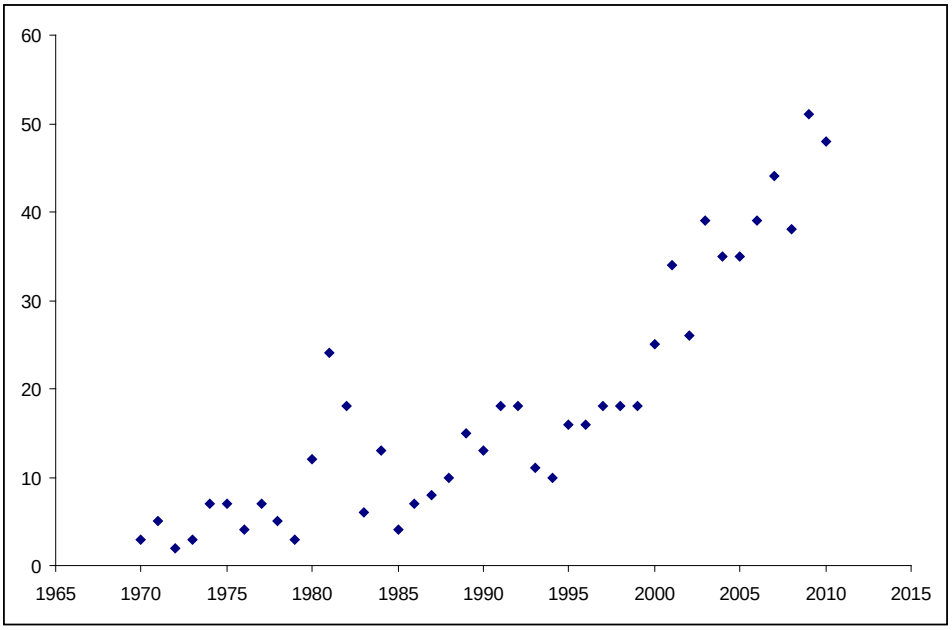

Figure 5. Number of publications on endosulfan and toxicity between 1965 and 2011. Retrieved from the SCOPUS database with search terms “endosulfan” and “toxicity”, retrieval data 11/03/2011

The search in the SCOPUS database presented in Figure 5 comprises 740 publications on endosulfan and toxicity. The 40 affiliations with more than four hits make up almost 40% of these publications (282) and are listed in Table 12. India (108), United States (63), Australia (17), Portugal (17), Spain (15) and Canada (14) are the countries with the most publications of endosulfan and toxicity (Table 12).

Table 12. Top 40 institutes publishing on endosulfan and toxicity in the period 1965-2011 ranked by country.

Country	Affiliation	Country	Affiliation
-	University of Agriculture (4)	India	Andhra University (5)
Argentinia	Universidad Nacional del Litoral (5)	India	Indian Veterinary Research Institute (4)
Australia	University of Technology Sydney (7)	India	Sri Venkateswara University (4)
Australia	Royal Melbourne Institute of Technology University (5)	India	Sri Krishnadevaraya University India (4)
Australia	NSW Environment Protection Authority (5)	Norway	Nasjonalt instiutt for ernærings- og sjømatforskning (5)
Brazil	Universidade Federal do Parana (4)	Portugal	Universidade de Aveiro (8)
Canada	University of Guelph (8)	Portugal	Faculdade de Ciências e Tecnologia da Universidade de Coimbra (5)
Canada	Environment Canada (6)	Portugal	Instituto Politcnico de Beja (4)
Germany	Technische Universität Braunschweig (5)	South Africa	Universiteit Stellenbosch (4)
India	Indian Institute of Toxicology Research (35)	Spain	Universitat de Valencia (15)
India	Acharya Nagarjuna University (11)	Turkey	Dicle Üniversitesi (6)
India	D.A.V. College Muzaffarnagar (8)	Turkey	Mehmet Akif Ersoy Üniversity (5)
India	Patna University (7)	USA	United States Environmental Protection Agency (16)
India	Indian Agricultural Research Institute (7)	USA	University of South Carolina (9)
India	Deen Dayal Upadhyay Gorakhpur University India (6)	USA	USDA Agricultural Research Service, Washington DC (8)
India	Visva-Bharati University (6)	USA	Florida International University (7)
India	Tamilnadu Agricultural University (6)	USA	UC Berkeley (7)
India	Punjab Agricultural University India (5)	USA	Southern University and A&M College (6)
India	Banaras Hindu University (5)	USA	UC Davis (5)
India	Central Institute of Fisheries Education India (5)	USA	University of California, Riverside (5)

Number of hits per affiliation using the search terms “toxicity” and “endosulfan” in the SCOPUS database are provided in brackets. Retrieval data 11/03/2011

6.2 Toxicity to honey bees

There is debate about the toxicity for honey bees, in which it is often stated that "*Endosulfan is one of the only ‘in-use’ pesticides that have a discriminating feature of saving pollinators and beneficials while targeting harmful pests."*

According to the Environmental Health Criteria 40 endosulfan is considered to be of moderate or low toxicity for honey bees (WHO, 1984). The WHO (1984) based this consideration on the publication of Stevenson et al (1978) who reported a LD50 of 7.1 µg/bee and an oral LD50 of 6.9 µg/bee for endosulfan. In the re-evaluation of endosulfan by US-EPA in 2002 it was concluded that *"Compared to those that are registered, including the organophosphates, malathion and dimethoate, endosulfan is less toxic to honey bees, which are crucial to the pollination of the alfalfa crop."* In de same publication a LD50 for honey bees of 4.5 ppm was provided, however without further reference.
In 2009 US-EPA carried out an extensive evaluation on endosulfan within the endangered species protection program. Three studies were evaluated and endosulfan was considered to be moderately toxic to honey bees. In this study both the LD/LC50s of 7.1 µg/bee and 4.5 µg/bee were evaluated as well a value of 6.9 µg/bee. Some additional data were provided as well. Moderate to high toxicity is confirmed in studies by Arzone (1984) and Suhail et al (2001). Arzone (1984) states that chemicals having insecticidal and acaricidal actions, even those declared harmless, are more or less hazardous to honey bees. In the documents delivered by Norway to the Rotterdam Convention one of the arguments for the prohibition of endosulfan in Norway was the toxicity to bees (see Annex 13).

6.3 Incidents with endosulfan

Environmental incidents with endosulfan have been reported in open literature (e.g.) as well as in governmental documents. Various accidents have been described in which fish have been killed because of regular use (The Netherlands, the United States), because of unintentional use (e.g. for killing snails in Thailand), or because of accidents with endosulfan (Brazil). The American cases have been summarized in documents delivered by the US-EPA for determining the effects for endosulfan and the California Red-legged Frog and the San Francisco Bay Species (US-EPA, 2009). The report lists 83 incidents of which almost 30% are categorised as 'highly probable'. Of these incidents, 67 involved mortality to fish. The terrestrial incidents and the incidents regarding plants were limited and in general less probable.
Besides these environmental examples, there are a number of cases where humans were affected by exposure to endosulfan, either swallowing intentional or unintentional, by unprofessional handling of the pesticide, by accident, or through the consumption of food. A number of illustrative cases on poisoning are provided in the Monograph of endosulfan (WHO, 2000). Human poisoning appears to take place world wide. Cases are known from at least India, Iran, Korea, Sri Lanka, Turkey and the United States. The cases in the Republic of Korea have been described by Moon & Chun (2009) and for Turkey by Durukan et al (2009). Parbhu et al (2009) describe the case of a 2.5-year-old American toddler who ingested an unknown amount of endosulfan from a 20-ounce soft drink bottle and Brandt et al (2001) describe the cases of two American Farmers. The study by Badarou & Coppieters (2009) focuses on poisoning with endosulfan through food intake in Benin. The self-poisoning in Sri Lanka resulted in a ban on problem pesticides, such as endosulfan, which was phased out in 1998 (Roberts et al., 2003). Khooharo (2008) states that most accidents happen in developing countries as most people are not aware of the dangers of pesticides. Sosan & Akingbohungbe (2009) made similar remarks and mention that 80% of the poisoning cases occur in developing countries. A selection of accidents has been provided in Table 13.

Table 13. Summary of some examples of accidents with endosulfan. Some of these have been caused by normal use.

country	year	description	reference
Sri Lanka	1994-1998	Rise in the number of deaths from status epilepticus from 1 in 1994 to 50 in 1998 attributed to endosulfan. After endosulfan was banned in 1998 number of deaths decreased to three in the three years after the ban.	Roberts et al., 2003
USA	1996	A large fish kill occurred in Bayou Rigolette and Bayou Rapids on or about June 10, 1996. The kill stretched between Grant and Rapides parishes. Endosulfan had been applied to neighboring areas and extremely heavy rain (over 9 inches) washed much of it into the bayous. Samples of water, sediment, and fish tissue indicated that endosulfan caused the fish kill.	US-EPA, 2009
Benin	1999/2000	Official sources in Benin state that at least 37 people died over the 1999/2000 season in the northern Borgou province due to endosulfan poisoning, while another 36 people experienced serious ill health.	Pesticides News No. 47, March 2000, pages 12-14
New Zealand	2005	Carl Houghton was fined $15000 plus court costs at Waitakere District Court in July for spraying endosulfan on 10 cattle at his Waimauku farm. His actions led to the suspension of New Zealand beef exports to Korea. Beef exports to seven other markets were also potentially affected. In passing sentence, his honour Judge Lindsay Moore, told Waitakere District Court that farmers needed to understand the significance and seriousness of the consequences of their actions. He said: “Anyone with any understanding of the importance of the meat trade to New Zealand … can only see in what happened here a disaster of national importance.” Another source mention the	New Zealand Food Safety Authority. Endosulfan: the story unfolds. Food Focus August 2007
Brazil	2008	Spill of 18,000 liters of endosulfan from a pesticide formulating plant into a tributary of the Paraiba do Sul river. Temporary shut down of drinking water intake and 300 metric tonnes of fish killed.	FIPERJ – Fundação Instituto de Pesca do Estado do Rio de Janeiro, 2008

A literature search in SCOPUS database with the search terms “endosulfan” and “poison*” resulted in 832 hits for the period 1965 to 2011. A limited number of articles, 42, were published in the period 1965 – 1995, and a large amount after 1995. Only 72 of these 832 articles were dedicated to deliberate self-poisoning.

6.4 Classification

The WHO Environmental Health Criteria on endosulfan (WHO, 1984) already reports about cases of accidental and suicidal poisoning and also concludes that endosulfan is extremely toxic to fish. Furthermore the report states that “*Endosulfan is moderately to highly toxic according to the scale of Hodge & Sterner (1956). The oral LD50 in the rat ranges from 18 to 355 mg/kg body weight.”* Surprisingly it classified both endosulfan and endosulfan sulphate in class II as moderately toxic.

The old WHO classification system is provided in Table 14 and shows that the oral LD50 observed for the rat and cited in WHO (1984) is below or at the lower range of class II. WHO (2009) recommended to classify endosulfan in GHS category 3, and provides an LD50 of 80 mg/kg as argumentation. A proper look in the data provided in the JMPR 1998 for endosulfan (WHO, 1998) and specifically the oral data in Table 2 of that publication (Acute toxicity of technical-grade endosulfan and its isomers and metabolites) may lead to the conclusion that a classification 'highly hazardous' is more in its place. Quijano (2000) reached a similar conclusion, as did several other authors. According to Agrow (2009) Bayer decided to phase out endosulfan after a decision, a number of years ago, to replace active ingredients in WHO class I by alternative and less toxic active ingredients. Bayer (2009) confirms this in a special statement and mentions that the liquid formulations are classified as class I.

Table 14. Toxicity classification of the WHO

WHO Toxicity Classification		Rat LD50 (mg of chemical per kg of body weight)			
class	description	solids (oral)	liquids (oral)	solids (dermal)	liquids (dermal)
Ia	extremely hazardous	< 5	< 20	< 10	<40
Ib	highly hazardous	5-50	20-200	10-100	40-400
II	moderately hazardous	50-500	200-2000	100-1000	400-4000
III	slightly hazardous	> 500	> 2000	> 1000	>4000

Besides the information available in the scientific literature substances may be classified in order to enable proper handling. This is often a long term process. Endosulfan has been classified by WHO in 1986 as moderately hazardous (class II), and is now classified as GHS class 3: toxic if swallowed or toxic in contact with skin (WHO, 2009). According to the US EPA endosulfan is highly toxic and is classified in class I. The International Agency for Research on Cancer (IARC), has not classified endosulfan as to its ability to cause cancer.

The data presented show that in the 1960's and 1970's limited data were available for a proper evaluation of endosulfan. Besides that, there was little awareness that pesticides could do harm. Quijino (2000) describe the registration of endosulfan by the Philippine Fertiliser and Pesticide Authority, which was created in 1977 and state that "*endosulfan was registered with the assumption of safety without any rigorous evaluation of the potential risks*." After the early 1980's that awareness was raised and several national and international bodies took action to carry out more thorough evaluations. The US-EPA published there first evaluation of endosulfan on line in 1987. In the Netherlands, the risks of endosulfan were evaluated at the end of the 1980's and the Philippines took action in the early 1990's. This process is further described in chapter 10. It can thus be concluded that the negative impacts of endosulfan became only clear more than 30 years after its introduction.

7 Maximum Residue Limits (MRL's) for endosulfan

There have been complaints from some tea producing countries about a unilateral decision by the EU should have made to reduce the MRL for tea in order to force tea planters not to use endosulfan. That was reason to explore the MRLs for endosulfan by putting these MRL's in a historical perspective and by comparing the EU MRLs (EU, 2011) with those of the worldwide MRL's in the Codex Alimentarius (FAO/WHO, 2010).

7.1 Endosulfan MRLs in general: Codex alimentarius and Europe

First efforts to come to tolerance levels for endosulfan date from 1965 when the Joint Meeting of the FAO Committee on Pesticides in Agriculture and the WHO Expert Committee on Pesticide Residues (JMPR) discussed endosulfan and published a first paper. The meeting concluded "The toxicological data are inadequate to estimate an acceptable intake for man." Since 1965 endosulfan has been reviewed many times.
In the 1967 evaluation of the JMPR a number of national tolerance levels for endosulfan in fruit and vegetables, which varied between 0.5 and 2.0 mg/kg, were provided. However, the JMPR meeting concluded that it could not recommend a tolerance level as no acceptable daily intake level was available. The first generally accepted tolerance level was dedicated to endosulfan in fruit, and was published in 1968. The Joint Meeting only recommended a temporary MRL for fruit and vegetables of 2 mg/kg until 1971 and advised further research (FAO, 1969). A limited number of studies were available at the time this MRL was set.
In the 1971 evaluation (FAO/WHO, 1973) a first set of tolerance levels were recommended. The tolerance level for fruit and vegetables was kept on 2 mg/kg and new tolerance levels were added for tea, cottonseed and rice. Although the table in the document (Table 15) provides recommendations for tolerances, temporary tolerances and practical residue levels it did not further elaborate on the temporality or the practicality of the tolerance levels.

Table 15. Recommendations for tolerances, temporary tolerances or practical residue limits.

Commodities	Tolerances (mg/kg)
Tea (dry, manufactured)	30
Fruits and vegetables	2
Cottonseed	0.5
Cottonseed oil (crude)	0.2
Rice (unpeeled)	0.1

Further tolerance levels were set in 1975 (FA)/WHO, 1975). These MRLs are provided in Table 16. The present Codex tolerance levels are provided in Table 17. When comparing Table 15 and 16 with the present Codex MRLs in Table 17 it becomes clear that most MRLs have been set to a lower level since 1975. The MRL for potatoes has been reduced by a factor of 20, cotton seed by a factor of 3 and milk by a factor of 50. The MRL for tea has not been reduced since 1971.

Table 16. Endosulfan tolerances in food. Source: FAO/WHO, 1975

Commodities	Tolerances (mg/kg) [a)]
Tea (dry, manufactured)	30
Fruits and vegetables (others than exeptions noted)	2
Carrots, potatoes, sweet potatoes, bulb onions	0.2
Cottonseed	1
Cottonseed oil (crude)	0.4
Rice (in husk)	0.1
Milk and milk products (fat basis)	0.5
Fat and meat	0.2

a Tolerance calculated as the total of alpha- and beta-endosulfan plus endosulfan sulphate.

European MRLs are laid down in Regulation (EC) 149/2008, which consists MRLs for a larger number of commodities than the Codex alimentarius. The EU MRLs can be found at the EU pesticide MRL database (EU, 2011). Most of the EU MRLs for endosulfan in products are either similar or lower than the Codex MRLs. Recently Ends Daily (04042011) reported that the European Commission had lowered MRLs for 13 active ingredients, including endosulfan. The new MRLs are laid down in Regulation (EC) 310/2011. From the article in Ends daily it becomes clear that setting MRLs have to take account of Green pesticide and consumers groups that bring in arguments on public health, foreign countries which argument unfair trade barriers are created and farmers that have to comply with the standards through their agricultural practice. Ends Daily (04042011) reports that MRLs were increased in 2008 because of complaints from foreign countries, but the present lowering of a number of MRLs were the based on the finding that a number of existing MRLs were not safe. In doing so it followed recommendations from the European Food Safety Authority (EFSA).

7.2 Endosulfan MRLs for tea

The MRLs in tea have resulted in a lot of discussions during the last decades. These discussions have been partly summarized in an unclassified document of the OECD from 2002 (OECD, 2002). The document illustrates that changes in the MRLs for pesticides in tea in Germany were the result of an increased monitoring of tea imports, especially by consumer groups. Normally, MRLs are set at levels that reflect the minimum quantities of the pesticide applied for adequate pest control on one side and the toxicological acceptable level on the other. When no sufficient data are available Germany applied the limit of determination as a default. An approach also followed by the EU.
The approach resulted in protest from exporting countries. The OECD (2002) reports that the Indian Government wrote a communication to the WTO's Trade and Environment Committee that *"Tea exports have been affected due to developed countries' concerns about pesticide content. Although Indian exporters adhered to the maximum pesticide residue levels recommended by US Environmental Protection Agency (EPA), stricter limits (e.g. 0.01 mg [sic] of tetrafidon and 2 mg of ethion per kg of tea) imposed in some European countries became insurmountable, there being, apart from other problems, a cost of USD 234 per analysis"* OECD (2002) further reports that the Tea Board of India advised growers on proper application of pesticides, including and in particular dicofol, endosulfan, ethion and tetradifon. Recently a Chinese publication entitled "Empirical analysis of the impact of EU's new food safety

standards on china's tea export" (Yue et al., 2010) focus on the same issue and indicate that new limits will decrease the exports of tea producing countries.

Table 17. Maximum residue limits for commodities from the Codex alimentarius. Download 06/03/2011.

Maximum Residue Limits for Endosulfan Commodity	MRL	Year of adoption	Note
Avocado	0.5 mg/Kg	2007	
Cacao beans	0.2 mg/Kg	2007	
Coffee beans	0.2 mg/Kg	2007	
Cotton seed	0.3 mg/Kg	2007	
Cucumber	1 mg/Kg	2007	
Custard apple	0.5 mg/Kg	2007	
Egg plant	0.1 mg/Kg	2007	
Eggs	0.03 mg/Kg	2007	(*)
Hazelnuts	0.02 mg/Kg	2007	(*)
Kidney of cattle, goats, pigs and sheep	0.03 mg/Kg	2007	(*)
Litchi	2 mg/Kg	2007	
Liver of cattle, goats, pigs & sheep	0.1 mg/Kg	2007	
Macadamia nuts	0.02 mg/Kg	2007	(*)
Mango	0.5 mg/Kg	2007	
Meat (from mammals other than marine mammals)	0.2 mg/Kg	2007	(fat)
Melons, except watermelon	2 mg/Kg	2007	
Milk fats	0.1 mg/Kg	2007	
Milks	0.01 mg/Kg	2007	
Papaya	0.5 mg/Kg	2007	
Persimmon	2 mg/Kg	2007	
Potato	0.05 mg/Kg	2007	(*)
Poultry meat	0.03 mg/Kg	2007	(*)
Poultry, Edible offal of	0.03 mg/Kg	2007	(*)
Soya bean (dry)	1 mg/Kg	2007	
Soya bean oil, Crude	2 mg/Kg	2007	
Squash, summer	0.5 mg/Kg	2007	
Sweet potato	0.05 mg/Kg	2007	(*)
Tea, Green, Black (black, fermented and dried)	30 mg/Kg		

(*) =At or about the limit of determination.
(fat) = (for meat) The MRL/EMRL applies to the fat of meat.

Both China and India have anticipated the discussions on tea. Both countries have been active in the scientific arena as well within the Joint FAO/WHO food standards programme. Within the programme activities are focussed on keeping the standards as they are.
The report from the 30th meeting on the Codex Alimentarius Commission meeting indicates that there has been discussion on the revocation of some CXLs (Codex Maximum Residue Limit for Pesticide) for endosulfan: "*Some delegations were in favour of revocation of CXLs, recommended by 2006 JMPR for withdrawal. However, the delegations of China and India proposed to retain the CXL for tea for four years under the Periodic Review Program. The*

Delegation of the EC expressed reservation on the advancement of MRLs for cucumber and melons, except watermelons as estimated short-term intake exceeded the ARfD in the exposure assessment conducted in the UK." (FAO & WHO, 2007). According to the JMPR report of 2006 endosulfan is used on tea in China, Japan and Malaysia. The JMPR meeting was not able to recommend a maximum residue limit for tea as supervised trials from India could not be matched against provided Good Agricultural Practices (GAPs) from China, Japan and Malaysia and thus the Meeting recommended the withdrawal of the previous recommendation of 30 mg/kg for green and black tea (FAO, 2006). More recently, the Working Group on MRL of the FAO Intergovernmental group on Tea prepared a policy statement on pesticide residues in tea infusion infused from dry tea and pleads for more focus on the brew. A trial in which endosulfan was included in this document (OECD, 2011).

The scientific literature indicates that there are several ways to overcome the low limits, some of which have already been mentioned in the OECD (2002) document. Xia et al (2008) indicate that a lower MRL for endosulfan (10 mg/kg is mentioned in the document) will result in a longer period between applications and harvesting. Gurusubramanian et al. (2008) discusses the issue of pesticides and tea extensively in a paper entitled "Pesticide usage pattern in tea ecosystem, their retrospect and alternative measures". A few of the co-authors are employed by the Indian Tea Research Association. In the abstract they state: "*The growing concern about the pesticide residue in made tea, its toxicity hazards to consumers, the spiralling cost of pesticides and their application have necessitated a suitable planning which will ensure a safe, economic as well as effective pest management in tea. At present it is a global concern to minimize chemical residue in tea and European Union and German law imposed stringent measures for the application of chemicals in tea and fixed MRL values at < 0.1 mgkg-1 for the most commonly used pesticides which will not be met out in the real practice and has been a major constraint to tea exporting countries like India."* One of the measures taken by the Indian Government is to limit the number of pesticides to be applied on tea. The paper focuses on pesticide regulation by means of alternative measures, such as integrated pest management, mechanical and physical control. The change of the producers of the more expensive teas made to organic production has also been described in OECD (2002).

Table 18. Maximum residue levels for a number of pesticides in tea as set by the EC. Data from Gurusubramanian et al (2008).

Pesticide	CODEX-MRL (mg/kg)	EC-MRL (mg/kg)	US-EPA MRL (mg/kg)
Abamectin	-	0.02	-
Acephate	-	0.05	-
Aldrin/Dieldrin	-	0.02	-
Bifenthrin	-	5.0	-
Buprofezin	-	-	-
Carbendazim	-	0.1	-
Carbofuran	-	0.2	-
Cartap	-	0.1	-
Chlorpyrifos	-	0.1	-
Copperoxychloride	-	*	-
B-cyfluthrin	-	0.1	-
Cypermethrin	-	0.5	20
Deltamethrin	10	5	-
Dicofol	8	20	45
Diflubenzuron	-	-	-
Dimethoate	-	0.05	-
Endosulfan	30	30	24
Ethion	5	3	10
Fenitrothion	-	0.5	-
Fenpropathrin	-	-	-
Fenvalerate	-	0.05	-
Formothion	-	0.05	-
Glyphosate	-	2	-
Hexaconazole	-	0.05	-
l-cyhalothrin	-	1	-
Lindane	-	0.05	-
Malathion	-	0.5	-
Monocrotophos	-	0.1	-
Oxydemeton methyl	-	0.05	-
Paraquat	-	0.1	-
Phosalone	-	-	-
Profenophos	-	0.1	-
Propargite	-	5	-
Propiconazole	-	0.1	-
Quinalphos	-	0.1	-
S-421	-	-	-
Simazine	-	-	-
Sulphur formulation	-	*	-
Tridemorph	-	20	-
2,4-D amine salt	-	0.1	-

A reduction in MRLs for endosulfan in tea has not been found in the European database on MRLs, or in the European legislation. Even in the new proposals by EU Directorate SANCO mid 2010 the value of 30 mg/kg is maintained. From the overview provided in Table 18, it is clear that the MRLs for endosulfan is relatively high compared to the other pesticides.

8 Alternatives for endosulfan

A move away from endosulfan raises the question of alternatives. It has been suggested that there is a limited amount of alternatives for endosulfan and that phasing out endosulfan is initiated to put high priced alternatives on the world market. These arguments will be further explored.

The countries which have phased out endosulfan until now, some already since the 1980's, have not indicated that they lack the presence of good alternatives. A large number of alternatives have been identified in the annex F questionnaires, but a further search delivered more information on alternatives. Most attention in this chapter is dedicated to cotton as most endosulfan is applied on cotton (see chapter 5).

Togo mentioned in their annex F information (UNEP, 2010b) that the alternatives for application in cotton has already started during the 2009-2010 production campaign. From the same region Martin et al. (2005) reported the use of microencapsulated endosulfan to limit environmental and health problems linked with the use of endosulfan, and the encouragement of the application of the insecticides indoxacarb and spinosad in cotton. Results from experiments with insecticides applied to cotton in Cameroon showed spinosad, thiodicarb and emamectin-benzoate to be the most suitable alternatives to reduce damage of bollworms, whereas indoxacarb and lufenuron were less effective (Achaleke et al., 2009a). The Indian Central Institute for Cotton Research (Central Institute for Cotton Research, 2007) published a folder in 2007 dedicated to the management of the American Bollworm (*Helicoverpa armigera*). The folder produced under the Technology Mission on Cotton and funded by the Indian Ministry of Agriculture list a number of insecticides recommended for the management of the American Bollworm. The folder lists a number of insecticides such as Thiodicarb, Acephate, Chlorpyrifos, Indoxacarb, Emamectin benzoate and Spinosad. The leaflet also mentions a number of non chemical management options such as pheromone traps and mechanical removal. Surprisingly, endosulfan is not being mentioned as a recommended insecticide for the American Bollworm in this Leaflet (annex17). Worth mentioning is also the citation of Cotton Australia in Cuddy (2010): *"Cotton Australia said the use of all pesticides in the industry had dropped 85 per cent in the past decade, so the ban would be unlikely to damage the industry. ''It's one less weapon in the arsenal but it's not a weapon that is that widely used,'' said the group's chief executive, Adam Kay."*

One of the complaints raised on the alternatives is that most of the alternatives are supplied by European multinational companies, which would gain profit by phasing out endosulfan. This would be disadvantageous for pesticide producing companies in the developing world, which mainly produce generic off-patented active ingredients. Therefore the information from annex F (UNEP, 2010b) and a few other sources have been gathered and analysed on the patent status and on the present producers. The data, presented in annex 18, show that most products proposed as alternative for endosulfan have been put on the market between 1955 and 1990. These products are off-patent. The data in the annex also show that there are a relative large number of companies producing these pesticides. Agrow (2006) for instance reports that 33 companies produce chlorpyrifos, 31 cypermethrin, 22 imidacloprid, 17 fenvalerate, 15 deltamethrin

and 15 dimethoate. However, indoxacarb and spinosad are still under patent. Thus, the argument might be valid for the relatively new insecticides indoxacarb and spinosad, but definitely not for the older insecticides such as chlorpyrifos, profenofos and thiodicarb, which are produced off-patent in developing countries. The new insecticides spinosad and indoxacarb are both still patented and are marketed by Dow AgroSciences, United States and DuPont Agricultural Products, United States respectively.

A second complaint was that alternatives would be much more expensive for farmers than endosulfan. Data on insecticide use and prices in Pakistan (Khoohora, 2008) enable to make a comparison between endosulfan and other insecticides. These data are summarized in Table 19. The data from Pakistan show that on a litre basis endosulfan is relatively cheap, but that there are various alternative products within the same price range or cheaper such as chlorpyrifos, dimethoate and fenvalerate. The study by Khoohora (2008) also report on recommended insecticides to combat whitefly (*Bemisia tabaci*) and American Bollworm (*Helicoverpa armigera*) in cotton. A number of these products are also mentioned in other sources (see annex 18; Achaleke et al., 2009a, 2009b). On a litre basis these products show to be more expensive than endosulfan, up to a factor of 20 for spinosad. The picture changes considerably when the comparison is based on a calculated price per surface area by multiplying recommended dose and price per litre. This seems more relevant than comparing on a price per litre basis. Application of spinosad for the American bollworm is still more expensive than the application of endosulfan. However, all the other insecticides are less expensive when expressed price per hectare. For a good comparison, the effectiveness of the insecticides should also be taken into account.

Table 19. Pesticides recommended for treatment of White fly and American Bollworm in cotton. Recommended dose per acre, recommended prices per litre, price per hectare and the relative prices (endosulfan = 100) are provided.

pest sprecies	recommended pesticide	dose ml/acre	price per liter (US $)	price per ha (US $)	relative price
White fly (*Bemisia tabaci*)	Acetamiprid 20 SP	150	6,72	2,49	59
	Imidacloprid 200 SL	250	5,41	3,34	79
	Endosulfan 35 EC	800	2,15	4,25	100
American Bollworm (*Helicoverpa armigera*)	Spinosad 240 EC	100	48,82	12,06	182
	Chlorpyrifos 40 EC	1000	2,60	6,41	97
	Endosulfan 35 EC	1250	2,15	6,64	100
	Profenofos 500 EC	1000	2,35	5,81	87
	Indoxacarb 150 SC	175	12,75	5,52	83
	Thiodicarb 80 DF	480	-	-	-

source: Khooharo, 2008. Prices provided by Department of Plant Protection, MINFAL, Karachi, amounts recommended by the Central Cotton Research Institute.

Data provided by Achaleke et al., (2009b) also show that the insecticides indoxacarb and spinosad are much more efficient in terms of amount of active ingredient needed than old pesticides such as DDT, endosulfan and profenofos. The LD50's for indoxacarb and spinosad were 0.8 and 1.6 µg active ingredient per gram larva for a range of strains of the bollworm (*Helicoverpa armigera*) compared to 33.6, 33.2 and 20.1 µg active ingredient per gram larva for DDT, endosulfan and profenofos respectively (Table 20). This also explains the much smaller amount of active ingredient needed per acre for indoxacarb and spinosad.

Table 20. The average toxicity (as LD50 in µg active ingredient per gram larvae) of a number of insecticides for different strains of the American Bollworm *Helicoverpa armigera* collected in Central Africa (after Achaleke et al., 2009b).

insecticide	DDT	endosulfan	indoxacarb	profenofos	spinosad
average LD50	33,6	33,2	0,8	20,1	1,6
standard error	8,0	4,8	0,3	9,4	0,6
n	7	6	6	6	6

The webpage Agropedia, funded by the Indian Council of Agricultural Research, and the annual report 2009/10 Coromandel International Ltd both report on an interesting development. Agropedia (2009) reports on the trends in the production of Bengal Gram (lentils) in Andhra Pradesh and specifically on the use of pesticides. After farmers had stuck to generic pesticides, such as acephate and quinalphos for 20 years and had rejected new products such as indoxacarb, novaluron and thiodicarb, they shifted to new products such as flubendiamide (Rallis, Bayer), and emamactin benzoate (Syngenta, Dhanuka) in 2008. Reasons for the shift were severe problems with caterpillars and the high price of the generic substances. The author state that the farmers preferred flubendiamide, because it is efficient in the control of caterpillars, it has a longer duration and because it is safe to crop and humans. Coromandel also mentions an "*Increased adoption of high value products by farmers was witnessed leading to drop in volumes of high dosage generics."* Advantage was that turnover of the company increased by 10%, whereas the volume of generics dropped by almost 20%.

9 Discussion

The information collected for the various countries shows that at least 70 countries have phased out endosulfan based on its hazardous properties (chapter 5). The hazardous properties of endosulfan became apparent in the 1980's and since than various efforts have been made to limit the risks of endosulfan nationally and internationally (chapters 5). A number of incidents with endosulfan have been described in chapter 6.
Nineteen countries have phased out endosulfan since 2005 including the EU (counted here as 1). In 2007 endosulfan was still authorised in 14 EU countries. Six countries (Argentina, Australia, Brazil, Canada, Paraguay and the United States) published a phase out to be effective in the next years, whereas at least two other countries announced to phase out endosulfan (Japan, Republic of Korea; see table 21).

Table 21. Status of endosulfan in a number of countries which has phased out endosulfan since 2005 and in some countries that planned to phase out endosulfan

country	**status**	**phase out since**
phase out effective since 2005		
Benin	banned	since 2008
Burkina Faso	banned	since December 2008
Cape Verde	banned	since December 2008
Chad	banned	since December 2008
Croatia	banned	since 2007
European Union (14 countries)	banned	since 2007
Gambia	banned	since December 2008
Ghana	banned	since 2008
Guinea-Bissau	banned	since December 2008
Iran (Islamic Republic of)	banned	since 2010
Malaysia	banned	since 2005
Mali	banned	since December 2008
Mauritania	banned	since December 2008
New Zealand	banned	since January 2009
Niger	banned	since December 2008
Senegal	banned	since December 2008
Serbia	banned	since January 2009
Slovenia	banned	since 2009/10
Switzerland	banned	since 2009
published phase out		
Argentina	authorised	phase out by 2012
Australia	authorised	phase out by 2012
Brazil	authorised	phase out by 2013
Canada	authorised	phase out by 2016
Paraguay	authorised	phase out by 2012
United States of America	authorised	phase out by 2016
announced phase out		
Japan		
Republic of Korea		

As Table 21 indicates, phase out schedules vary. Brazil ends the use of endosulfan within three years, whereas Canada and the United States phase out endosulfan over a period of six years. The phase out schedule of the United States is provided in annex 19. Phase out schedules of Belgium and Serbia are provided in annex 20.
Moving away from endosulfan may start with restriction on use and may take many forms. Restrictions may lead to the application in a limited amount of crops, in application of certain formulations or a prohibition on certain formulations and to descriptions considering use (See chapter 5 for some examples). In a number of cases countries have first restricted use of endosulfan, after which a total ban was introduced (e.g. the African Sahel countries). Sometimes the initiatives to phase out endosulfan are taken at regional or local level. The State of Rio de Janeiro, Brazil, banned endosulfan in December 2009 after an incident with a spill of 18,000 litres of endosulfan from a formulating plant resulting in kill of 300 metric tonnes of fish and shut down of drinking water supply. The formulating plant was fined. In 2010 the central Brazilian government decided to phase out endosulfan. There are more examples where the decision to limit the risks of endosulfan were taken regionally instead of the national authority.

Two of the arguments against a phase out will be highlighted here as the others have already been discussed in different chapters (e.g. on toxicology and incidents in chapter 6).
The present status of endosulfan enables world wide trade. European legislation, as well as American legislation, does not prohibit the trade in pesticides which are still in use elsewhere, as it would limit free trade. Those who experience that as a problem should be in favor of listing endosulfan as a persistent organic pollutant under the Stockholm Convention as it is the only mechanism to forbid production, marketing and use (see chapter 4).
Some of the arguments brought forward to maintain endosulfan focus on either the price for the end user and the profit multinational companies would gain by selling their specific products. The data provided in chapter 8 indicate that farmers can choose from a range of products, both patented and off-patented. The off-patented products are often produced in developing countries. In a number of cases alternatives that are cheaper than endosulfan are available. The data in chapter 8 also indicate that various stakeholders, farmers but also commodity organisations, are moving away from endosulfan. For instance, the Indian Central Institute for Cotton Research does not list endosulfan in their list of recommended pesticides against the American Bollworm. Also industries broaden their scope (see annex 2 and annual reports of these companies).

Private companies have to thrive to survive. The challenges the largest producer of endosulfan, Excel CropCare Ltd, encounters are described by Narula and Upadhyay (2010). Further information on the Indian producers can be found in annex 2 and the annual reports of these companies. Of these challenges, it is worth to mention the introduction of Bt cotton in the 1990's, which reduced pesticide use in cotton significantly, the problems companies from developing countries encounter on the international market because of the high standards set by the authorities for registration (see chapter 3) and competition at the national market by multinational companies that try to enlarge their registrations or lower the price of their earlier patented products. From this perspective it is understandable that objections from the Indian Chemical council have been raised within the scientific committee under the Stockholm Convention. Such objections are not limited to pesticide industries in developing

countries, or to recent years, which is illustrated by the following examples considering endosulfan. Hoechst and Luxan B.V. (subsidiary of Excel CropCare disputed the withdrawal of the registration in the Netherlands already in 1989, but their appeal was rejected (UNEP, 2005), Hoechst sent a letter in 1991 in relation with the possible listing of endosulfan for a prior informed consent procedure (chapter 4), Bayer objected on the proposal for listing endosulfan as a persistent organic pollutant (POP) in the UNECE Task Force in 2003, the Indian Chemical Council objected against listing of endosulfan for the Rotterdam Convention in 2010 (chapter 4) and Makhteshim objected against the phase out of endosulfan in the United States. On the Makhteshim website it states: *"From a scientific standpoint, MANA continues to disagree fundamentally with EPA's conclusions regarding endosulfan and believes that key uses are still eligible for re-registration,". "The Agency has made a number of overly conservative and unrealistic assumptions about how endosulfan is used that do not reflect the best available science. "However, given the fact that the endosulfan market is quite small and the cost of developing and submitting additional data high, we have decided to voluntarily negotiate an agreement with EPA that provides growers with an adequate time frame to find alternatives for the damaging insect pests currently controlled by endosulfan,"* Quijano (2000) describes the evaluation process and the prohibition of endosulfan in the Philippines in the early 1990's extensively and highlights the role of industry in this process. Negotiations between US EPA and various American companies on the export of some other hazardous pesticides have been described in Smith & Root (1999).

The examples provided on national restrictions or prohibitions (mainly in chapter 5) show that such decisions are often taken after extensive evaluation and they also indicate that such decisions are not lightly taken (e.g. Anvisa, 2010, Ize Lema, 2010, Health Canada, 2009, FIPERJ, 2008, UNEP, 2005). Interests of public health, agriculture and industry have to be weighted in a balanced matter. The examples provided in chapter 9 and in annex 1 indicate that interference by stakeholders and non-governmental organisations can be expected when making such a decision. Two examples of final statements on phasing out endosulfan are provided below.
The New Zealand Government (2009) indicated on their website communicating on endosulfan that endosulfan was an effective and relatively inexpensive insecticide, generally used infrequently as a last resort. They stated that "*After consideration of all the options, including the possible imposition of stricter controls on its use, the decision-making committee concluded that the level of adverse effects to the environment, human health, the relationship of Māori to the environment, and to New Zealand's international relationships outweighed any positive effects of the availability of endosulfan."*
The considerations of the United Kingdom Health and Safety Executive (UK-HSE) after the decision to phase out endosulfan within the European Union shows similar considerations: *"Endosulfan has some very niche uses and we were considering seeking some essential uses for endosulfan. However, in parallel to developing the agronomic case we also considered the draft review report for this substance. Our conclusion was that the risk profile of endosulfan is such that we did not consider it appropriate to seek a prolongation of its use beyond the phase out period routinely allowed. The position now is that endosulfan will be withdrawn within 18 months of the publication of the Commission's withdrawal decision, which has not yet appeared in the Official Journal. The existing uses of endosulfan will thus remain available in the UK for the 2005 and 2006 seasons*." (UK-HSE, 2005).

The report provides information on restrictions and phase out of endosulfan for various countries, and the considerations made in taking these decisions. It shows that limiting the hazardous properties of endosulfan may take various routes, either from restrictions to a total prohibition. For a decision on a global level it is necessary to gain a good impression on the arguments for a phase out, on the necessity to maintain endosulfan from different perspectives and to discuss the various options. The report offers information to have such a discussion.

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Annexes

Annex I. Overview of a number of websites commenting on the listing of endosulfan to the Stockholm Convention

Ban on 'Endosulfan' aimed at destroying India's exports: http://www.agrireview.com/index.php/en/component/k2/item/7-ban-on-endosulfan-aimed-at-destroying-indias-exports

Brazilian prosecutors push for chemical ban: www.patagoniasinrepresas.cl/accesopublico/...10/ecoamericasjune10.pdf

Central minister finds no fault with endosulfan: http://www.deccanherald.com/content/107865/central-minister-finds-no-fault.html

Endosulfan Poison Banned in NZ: http://www.theepochtimes.com/n2/content/view/8676

EU move to ban Endosulfan to benefit European Crop Protection Industry: http://www.business-standard.com/india/news/eu-move-to-ban-endosulfan-to-benefit-european-crop-protection-industry/423675/

Highly toxic Endosulfan found in lettuce, strawberries, courgettes: http://www.panap.net/en/p/post/pesticides/320

India opposes ban on endosulfan despite Kerala plea: http://www.thehindu.com/news/states/kerala/article834069.ece

India resists efforts to ban pesticide: http://www.washingtonpost.com/national/india-resists-ban-on-pesticide/2011/02/07/ABTvkZF_story.html

Indian tea industry is facing the impact of the EU decision to reduce the residue limit of endosulfan: http://www.teatronaturale.com/article/2526.html

India's chemical nightmare: http://www.guardian.co.uk/commentisfree/cif-green/2009/oct/04/india-pesticide-endosulfan-chemical

India's stand on Endosulfan wrong, says Benoy Viswom: http://www.hindu.com/2010/10/20/stories/2010102058580100.htm

International ban on endosulphan essential': http://articles.timesofindia.indiatimes.com/2010-11-29/interviews/28215083_1_endosulfan-aerial-spraying-cashew-plantation

ITUC Condemns Exclusion of Asbestos and Endosulfan from Global Export Regulation: http://www.ituc-csi.org/ituc-condemns-exclusion-of.html?lang=en

Pesticide makers oppose endosulfan ban moves: http://www.thehindubusinessline.in/2010/12/23/stories/2010122352951800.htm

Senior agronomists express concern, support India's position on Endosulfan: http://harolddoan.com/wordpress/2011/02/19/2353/

Use of banned pesticides brews trouble for coffee exporters: http://www.thehindubusinessline.in/2010/12/21/stories/2010122151151800.htm

Annex 2. Endosulfan production in India, An overview.

Narula & Upadhyay (2010) indicate that India has one of the most dynamic pesticides industries in the world with a total installed capacity of 125,000 metric tonnes technical grade installed. The activities are spread over ten multinational companies and 400 formulators. Production is dominated by off-patented insecticides such as malathion and endosulfan. Production of pesticides amount around 85,000 metric tonnes, whereas total Indian pesticide consumption is between 40,000 and 50,000 tonnes (Crisil, 2011; Narula & U., 2010). The numbers provided for capacity installed and amount produced are low compared the data mentioned in the annual report of Hindustan Insecticides Ltd (2003) which report a 145,000 tonnes installed capacity for pesticides and a production of 68,000 tonnes. (Annual report HIL, 2003). Indian pesticide consumption is dominated by insecticides (50-70%), in contrast to most other markets where herbicides are the most important product applied. Of the national pesticide consumption in 2001/02 45% was applied to cotton, 23% was used for the rice production, followed by vegetables (7%), wheat (8%) and pulses (4%). Towards 2010 the relative importance of paddy (rice) increased to 29% followed by cotton (26%) (Narula & Upadhyay, 2010). The importance of Cotton and rice (paddy) in the first place is confirmed in other documents.

According to the Annex F information endosulfan is produced in India on three locations. The Indian primary producers are Excel Crop Care Ltd, Coromandel International Ltd and Hindustan Insecticides Ltd who produce a number of pesticides at various locations. However, size and range of products and importance of endosulfan production differs a lot. Besides these three companies several Indian companies are active in formulating endosulfan.

Excel Crop Care Ltd
Excel Crop Care Ltd is a private company, based in Mumbai and employs around 1200 employees. It is one of the major domestic pesticide companies in India (Narula & Udaphyay, 2010). The original company was founded in 1941, and became a public company in 1965. The pesticide division branched of from Excel Industries Ltd in 2002. In 2004 the Australian company Nufarm acquired a 15% stake in Excel Crop Care Ltd. Associated companies within India are Aimco Pesticides Limited and Kutch Crop Services Limited, whereas Excel has subsidiaries in Europe (Excel Industries (Europe) N.V.) and Australia (Excel Industries (Australia) Pty Ltd).

Excel Crop Care Ltd only produces a few chemicals. Besides endosulfan Excel produces the insecticides chlorpyrifos, profenofos and imidacloprid, some fungicides and herbicides. Endosulfan is the largest selling product of Excel; more than 50% of the total turnover can be contributed to the production of endosulfan (Narula & Upadhyay, 2010). A marketing report reports that endosulfan contributed for over 40% to the total revenues in 2007 and for almost 35% in 2010 (Crisil, 2011). The marketing report also indicates that Excel Crop Care Ltd is gradually shifting its reliance on endosulfan to other products because endosulfan is banned in many countries (Crisil, 2011).
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Excel started producing endosulfan in a pilot plant in 1976 in Bhavnagar, Gujarat and was the first Asian producer of endosulfan and third in the world (Narula & Upadhyay, 2010). Excel also produces 2-butene-1,4-diol (CAS 110-64-5), one of the main intermediates for producing endosulfan. The plant producing 2-butene-1,4-diol was expanded in 1994-1995. Excel has an installed capacity for

producing pesticides and pesticides intermediates of 20.750 and 6.900 metric tonnes respectively. Quantities produced were 14.519 and 4449 metric tonnes in 2009 and 13.243 and 4448 metric tonnes in 2008. Licensed capacity is beyond the installed capacity. Some internet sources mention 6000 metric tonnes installed capacity for endosulfan, but this could not be confirmed by more official sources. Excel is one of the world's leading producers of endosulfan.

Excel exports its products to more than fifty countries worldwide (countries listed in: Narula & Upadhyay, 2010). In 2007 it completed registration of Endocel, the commercial product containing endosulfan, in China (Annual report 2007).

Both Narula & Upadhyay (2010) and the annual report 2010 indicate that Excel Crop Care has a relatively narrow product range and relies on the production of only a few products of which endosulfan is the most important. The risks of an approach which relies on a narrow product range and the strategies to overcome these risks are summarized in the annual report of 2010. Excel realises that it is necessary to widen the product range and to introduce newer pesticides and bio-products as well as safer formulations. The future action plan of Excel shows that the company realises the risk of heavily leaning on the production of only one product.

Hindustan Insecticides Ltd

Hindustan Insecticides Ltd (HIL) is a Government of India Enterprise, positioned under the Ministry of Chemicals & Fertilizers. HIL employs at present around 1500 employees.

Hindustan Insecticides Limited (HIL) was established in 1954 when WHO provided India with a plant to produce DDT for the National Malaria Eradication Programme. The plant was set up in Delhi and started production of DDT in 1955. In 1957 a second plant was set up for the production of DDT formulations at Udyogamandal, Kerala. Further plants were set up in 1971 for the production of hexachlorocyclohexane (BHC), in 1977 for the production of malathion and in 1983 for the formulation of DDT. For diversification purposes further plants were set up for producing endosulfan, for the production of butachlor and monocrotophos in Rasayani in 1991, for the production of dicofol in 1996 in Udyogamandal and for producing mancozeb in 2002-03. The factory in Delhi was closed in 1996. The annual report mentions three primary production locations, one at Udyogamandal, Kerala (1958), one at Rasyani, Mahrashtra near Mumbai (1997) and one near Bathinda in Punjab (2003). Production of endosulfan takes place in the plant at Udyogamandal, Kerala and has probably started somewhere between 1983 and 1996.

Totally installed production capacity for all pesticides as reported in 2003 was 145,000 metric tonnes with a production of 68,000 tonnes (annual report 2003). Production of pesticides and insecticides between 2003 and 2009 ranged between 83,000 and 94,000 metric tonnes. Main products in the period 2003 to 2009 were DDT (3300-4500 tonnes/year), malathion (2000 – 4700 tonnes), monocrothphos (4500-9500), cypermethrin (4000-6500), chlorpyrifos (4000-9000), mancozeb (17,000 – 35,000) and isoproturon (3000 – 4500 metric tonnes/year). Installed capacity for endosulfan in 2003 was 10,100 metric tonnes and production was 3.7000 metric tonnes (annual report 2003). For the period 2003 – 2009 production of endosulfan ranged between 2900 to 4200 metric tonnes per year. Production of endosulfan by Hindustan Insecticides Ltd during the years 2003 – 2010 showed to be relatively stable (Table 1). Present

sources sometimes mention 1600 metric tonnes as installed capacity for endosulfan.

Table 1. Production of endosulfan by Hindustan Insecticides Ltd between 2003 and 2010 in metric tonnes. Source: Annual report 2009-2010, (HIL, 2011)

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Endosulfan	3597	3054	2939	3898	3960	4263	2376

The figures for 2009-10 gives production for the period April - December 2009

Hindustan Insecticides Ltd exports its products worldwide. The annual report 2003 mentions exports to USA, UK, France, Netherlands, Belgium, Spain, South Africa, Bangladesh, Malaysia and Singapore. More recent reports mention a much larger range of countries, with Europe, South America, the Gulf region and South-East Asia as most important areas.

Coromandel International Ltd

Coromandel International Ltd was established in 1961 as Coromandel Fertilisers Ltd. Coromandel International Ltd is part of the Murugappa Group and has its head office in Cennai. Coromandel International Ltd is a subsidiary of EID Parry, which is named as producer of endosulfan in a lot of older documents. EID Parry was established in 1788 and became a part of the Murugappa group in 1981. In 2008/09 a subsidiary company, Coromandel Brazil Ltd was established in order to strengthen the position of Coromandel on the South American market. Coromandel produces a range of phosphate fertilisers and pesticides.

Coromandel produces both technical products and formulations. The pesticide plants are located at Ankleshwar (Gujarat), Thane (Maharashtra), Ranipet (Tamil Nadu) and Jammu (J&K). The installed production capacity for pesticides is 13,900 metric tonnes for the technical product, 10,900 metric tonnes for the liquid formulations and 5600 metric tonnes for the other formulations (Annual report 2007). As production is lower than the capacity DuPont and Indian based De-nocil Crop Protection Pvt Ltd started making use of the spare capacity of the production plant in Ranipet in 2007. Total production of technical products for 2007/08 was almost 6500 metric tonnes, almost 5000 metric tonnes for the liquid formulations and almost 3000 metric tonnes for the other formulations (Annual report 2007/08). Numbers for endosulfan were not provided. Production of endosulfan is carried out at Thane (Maharashtra). The annual reports of 2008/09 and 2009/10 report that the Thane plant achieved new production records and that both endosulfan and profenofos showed growth.

Coromandel is the third largest producer of endosulfan. Further important products mentioned in the annual reports are phenthoate, terbufos, and profenofos. The pesticides are mainly exported to South America (Annual report 2006/07). Pesticides account for almost 10% of the turnover of Coromandel International Ltd (website Murugappa group, 2011). Endosulfan and malathion contributes most to the turnover of the company as far as it concerns export (Annual report 2007/08).

Coromandel has identified the risks associated with their business and also defined strategies to overcome these risks. Coromandel is well aware of the fact that some of their products may be restricted in India or abroad. Development of new and safer products, extension of the life cycle and education of users in order to use the products properly has been identified as important steps in the mitigation strategy (annual report 2006/07). The 2009/10 annual report

indicates that Coromandel focus on stewardship activities for endosulfan and public relations in order to handle negative publicity on certain products. It also report on increased R&D activities to develop new products, higher co-marketing activities to access new products and an increase of production of other technical products. Annual reports are available at Coromandel (2011).

Formulators

Besides these three primary producers several Indian companies are active in formulating endosulfan including Bayer CropScience India Limited which acquired Aventis CropScience India in 2003 and Makhteshim-Agan India Pvt Ltd, founded in 2009. Only limited attention is given here to Bayer CropScience India Ltd here.

In 2003 Bayer acquired Aventis CropScience. Production of endosulfan is not mentioned in the 2002 Annual report of Bayer CropScience India Ltd, but is in the later ones. From 2003 to 2008 an amount of between 542 and 863 metric tonnes was used annually by Bayer CropScience India Ltd for producing formulated endosulfan; see Table 2 (Bayer India, 2011a). The 2009 Annual report only provides data for pesticides and not for the individual substances. Based on the last reported data a price per metric tonne of endosulfan produced of 4702.10 US $ can be estimated.

Table 2. Raw material bought by Bayer India Ltd in quantity and price. Data from annual reports Bayer CropScience India Ltd.

year	raw materials consumed	quantity (tonnes)	value ('000) Rupees
2001	-	-	-
2002	-	-	-
2003	Endosulfan Tech	542	124,544
2004	Endosulfan	776	166,505
2005	Endosulfan Tech	824	179,194
2006	Endosulfan Tech	713	155,007
2007	Endosulfan Tech	863	182,131
2008	Endosulfan Tech	788	167,192
2009	-	-	-

Total amount produced

The amount of installed production capacity and amount of pesticide(s) produced are provided in Table 3. The production data, as provided in Table 3, do not allow estimating the precise amount of endosulfan produced as Excel CropCare and Coromandel International Ltd did not provide data on individual pesticides. However, knowing that endosulfan is an important product for both Excel Crop Care Ltd and Coromandel International Ltd enables to make a rough estimation.

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Table 3. Overview of the production capacity installed and actual produced pesticides.

producer	production of	installed metric tonnes	produced metric tonnes	year	source
Excel Crop Care Ltd	pesticides	20.750	14.519	2010	Annual report 2010
	pesticide intermediates	6.900	4.449		
Coromandel International Ltd	technicals	13.905	6.483	2007/08	Annual report 2003/04
	formulations liquid	10.900	4.916		
	formulations others	5.600	2.829		
Hindustan Insecticides Ltd	endosulfan	10.100	3.700	2003/04	Annual report 2007/08

Sources: Excel Crop Care Ltd: Annual report 2010, Coromandel International Ltd: Annual report 2003/04, Hindustan Insecticides Ltd: Annual report 2007/08

Using the production of the technical products (metric tonnes) and assuming a contribution of endosulfan of 30% in the total production for both Excel and Coromandel result in a total amount produced in India of 9,200 metric tonnes (4400 + 1900 + 2900), assuming a 40% share result in a production of 12,100 metric tonnes (5800 + 2600 + 3700) and assuming a share in the production of 50% result in a produced amount of 14,700 metric tons per year (7300 + 3200 + 4200). The amounts are slightly higher than the amount of 9000 metric tonnes reported in the annex F report. The amounts of 2900 and 4200 tonnes represent the minimum and maximum amount produced by HIL between the period 2003 and 2009, 3700 tonnes was the actual amount in 2003/04.

Key data

The key data for the three Indian endosulfan producers are summarized in Table 4. Total production of Hindustan Insecticides is based on the production data for the period 2003-2009 (Table 1). Annual production for Excel Crop Care Ltd and Coromandel International Ltd is recalculated from total pesticide production and assuming that the contribution of endosulfan on the total pesticide production is between 30 and 50%. Both Excel Crop Care Ltd and Hindustan Insecticides Ltd mainly produce pesticides. In the case of Excel endosulfan is one of the main products within a relatively narrow range of pesticides produced. Hindustan produces a much broader range of products and based on the production data of 2003 contribution of endosulfan is estimated to be less than 5% pesticides contribute for less than 10% to the total turnover of Coromandel International Ltd; main products are phosphate fertilisers. As it is stated that both endosulfan and malathion contribute most to the turnover of the company, contribution of endosulfan is assumed to be less than 5%, but precise percentage is difficult to establish.

Table 4. Summary of the key data of the three Indian producers of endosulfan

Company	annual production (metric tonnes per year)	contribution endosulfan in total revenues	number of employees	turnover (mn Rs)	profit after tax/net profit (mn Rs)	profit after tax/net profit (mn US $)
Excel Crop Care Ltd	4400-7300 [1)]	> 35%	1200	6445	371	8,3
Coromandel International Ltd	1900-3200 [1)]	< 5% [2)]	7000	64821	4677	104,7
Hindustan Insecticides Ltd	2900-4200	< 5% [3)]	1500	215	27	0,6
total production	9200-14700					

1 = based on the assumption of 30-50% contribution of endosulfan to the total pesticide production. The amount provided for Hindustan is the range actual produced between 2003 and 2009

2 = contribution of all pesticides to the total revenues of Coromandel is almost 10%, endosulfan and malathion contribute most to the turnover

3 = contribution based on amount produced in relation to all pesticides

From the profit after tax of the three companies it can be estimated that the sales of endosulfan contributes for a maximum of 20 million US $ to the Indian economy. Its share in turnover is estimated to be maximal 300 million US $. Agrow (2006) estimated the total production of endosulfan to be less than 280 million US $ in 2004.

Annex 3. Registered endosulfan products in Canada. Source. Health Canada, 2009.

Marketing class	Registrant	Product Name	Formulation Type	Guarantee
Technical	Makhteshim Agan of North America Inc.	Thionex (Endosulfan) Technical	Solid	95%
Technical	Bayer CropScience Inc.	Endosulfan Technical Active Insecticide	Solid	96%
Manufacturing concentrate	Bayer CropScience Inc.	Thiodan Manufacturing Use Product	Wettable Powder	50%
Commercial	United Agri Products Canada Inc.	Thionex 50W Wettable Powder Insecticide	Wettable Powder	50%
Commercial	Makhteshim Agan of North America Inc.	Thionex 50WP Endosulfan Commercial Insecticide	Wettable Powder	50%
Commercial	Bayer CropScience Inc.	Thiodan 4EC Insecticide Liquid Emulsifiable Concentrate	Emulsifiable Concentrate	400g/L
Commercial	Makhteshim Agan of North America Inc.	Thionex EC (Endosulfan) Insecticide	Emulsifiable Concentrate	400g/L

Annex 4. Imports of endosulfan into Peru. Source: annex E information UNEP (2009)

Company	Commercial product	Country of origin	netto weight (kg)
2006			
Bayer S.A.	Thiodan 35 EC	Guatemala	13767
Bayer S.A.	Thiodan 35 EC	Guatemala	8472
Bayer S.A.	Thiodan 35 EC	Guatemala	12708
Bayer S.A.	Thiodan 35 EC	Guatemala	9531
Bayer S.A.	Thiodan 35 EC	Guatemala	10590
Bayer S.A.	Thiodan 35 EC	Guatemala	11649
Bayer S.A.	Thiodan 35 EC	Guatemala	11649
Farmagro S.A.	Thionex 35 EC	Israel	6785
Farmagro S.A.	Thionex 35 EC	Israel	6785
Silvestre Peru S.A.C.	Star 3 CE	USA	16907
Silvestre Peru S.A.C.	Star 3 CE	USA	16907
Silvestre Peru S.A.C.	Star 3 CE	USA	16907
2007			
Bayer S.A.	Thiodan 35 EC	Guatemala	11649
Bayer S.A.	Thiodan 35 EC	Guatemala	13767
Bayer S.A.	Thiodan 35 EC	Guatemala	15763
Bayer S.A.	Thiodan 35 EC	Guatemala	8242
Bayer S.A.	Thiodan 35 EC	Guatemala	12772
Quimica Suiza S.A.	Thionex 35 EC	Israel	12720
Quimica Suiza S.A.	Thionex 35 EC	Israel	8480
Silvestre Peru S.A.C.	Star 3 CE	USA	16907
Silvestre Peru S.A.C.	Star 3 CE	USA	17120
Soc. An. Fausto Piaggio.	Thionex 35 EC	Israel	5600[1)]
2008			
Serfi S.A.	Endosh	India	2
Bayer S.A.	Thiodan 35 EC	Guatemala	15763
Bayer S.A.	Thiodan 35 EC	Guatemala	13814
Bayer S.A.	Thiodan 35 EC	Guatemala	11292
Bayer S.A.	Thiodan 35 EC	Guatemala	6885
Bayer S.A.	Thionex 35 EC	Israel	6784

1) amount in liters

Annex 5. Registered formulations in Mexico, April 2011.

COMPANY	COMMERCIAL NAME	ACTIVE INGREDIENT
I AGREVO MEXICANA, S.A. DE C.V.	PARAMETHYL PLUS	ENDOSULFAN + PARATION METILICO "USO RESTRINGIDO"
I INSECTICIDAS NACIONALES COREY, S.A. DE C.V.	ENDOCORAL 30-15% C.E.	ENDOSULFAN + PARATION METILICO "USO RESTRINGIDO"
II AGM DE MEXICO, S.A. DE C.V.	BIOSULFAN 35	ENDOSULFAN
II AGREVO MEXICANA, S.A. DE C.V.	ENDOSULFAN TECNICO	ENDOSULFAN
II AGREVO MEXICANA, S.A. DE C.V.	THIODAN 50 P.M.	ENDOSULFAN
II AGREVO MEXICANA, S.A. DE C.V.	THIODAN 35 C.E.	ENDOSULFAN
II AGRICOLA INDUSTRIAL TAMAYO, S.A. DE C.V.	ENDOSULFAN 35%	ENDOSULFAN
II AGRICULTORES ASOC. DE SINALOA, S.A. DE C.V. E	NDOSULFAN 35%	ENDOSULFAN
II AGRICULTURA NACIONAL DE JALISCO, S.A. DE C.V.	THIOSULFAN 35-E	ENDOSULFAN
II AGRICULTURA NACIONAL, S.A. DE C.V.	FANTOM 35 E	ENDOSULFAN
II AGRICULTURA NACIONAL, S.A. DE C.V.	ENDOSULFAN TECNICO	ENDOSULFAN
II AGRO FARM INDUSTRIAL DEL PACIFICO, S.A. DE C.V.	SULTAN 35	ENDOSULFAN
II AGROFORMULADORA DELTA, S.A. DE C.V.	ENDOSULFAN 35	ENDOSULFAN
II AGROFRIENDS DE MEXICO, S.A. DE C.V.	AGROSULFAN 35	ENDOSULFAN
II AGROINDUSTRIAS DEL NORTE, S.A. DE C.V.	AGROSULFAN 35%	ENDOSULFAN
II AGROMUNDO, S.A. DE C.V.	ENDO 35	ENDOSULFAN
II AGROMUNDO, S.A. DE C.V.	ENDOSULFAN 95% T	ENDOSULFAN
II AGROMUNDO, S.A. DE C.V.	ENDOSULFAN TECNICO	ENDOSULFAN
II AGROQUIMICA DE URUAPAN, S.A.	ENDOSULFAN 35%	ENDOSULFAN
II AGROQUIMICA TRIDENTE, S.A. DE C.V.	TRIDANE 350 TRIDENTE	ENDOSULFAN
II AGROQUIMICOS RIVAS, S.A. DE C.V.	ENDOSULFAN 35-C.E.	ENDOSULFAN
II AGROQUIMICOS VERSA, S.A. DE C.V.	ENDOSULFAN 35%	ENDOSULFAN
II AGROQUIMICOS VERSA, S.A. DE C.V.	SUFAN 35 / BINGO 35	ENDOSULFAN
II AVENTIS CROPSCIENCE MEXICO, S.A. DE C.V.	THIODAN HF / GALA HF / CAPATAZ HF / PHASER HF	ENDOSULFAN
II AVENTIS CROPSCIENCE MEXICO, S.A. DE C.V.	THIODAN 50 PM/GALA 50 PM/CAPATAZ 50 PM/PHASER 50 PM	ENDOSULFAN
II BAYER DE MEXICO, S.A. DE C.V.	THIONEX 35 C.E.	ENDOSULFAN
II BAYER DE MEXICO, S.A. DE C.V.	ENDOSULFAN TECNICO / THIODAN TECNICO	ENDOSULFAN
II BAYER DE MEXICO, S.A. DE C.V.	THIODAN 35 CE/ PHASER 35 CE/ CAPATAZ 35 CE/ GALA 35 C.E.	ENDOSULFAN
II BAYER DE MEXICO, S.A. DE C.V.	ENDOSULFAN TECNICO	ENDOSULFAN
II BIESTERFELD DE MEXICO, S.A. DE C.V.	BIESTELFAN / ENDOPRO / ENDOMAX	ENDOSULFAN
II CHEMIMPORT, S.A. DE C.V.	ENDOSULFAN TECNICO	ENDOSULFAN
II DERMET, S.A. DE C.V.	DERFAN 35 Y/O FANMET 35	ENDOSULFAN
II EMPRESAS LONGORIA, S.A. DE C.V.	ENDOSULFAN 35% C.E.	ENDOSULFAN
II FERTILIZANTES E INSECTICIDAS MISION, S.A. DE C.V.	HORNET 350 / ENDOSULFAN 350	ENDOSULFAN
II FMC AGROQUIMICA DE MEXICO, S. DE R.L. DE C.V.	ZOLL 35 CE	ENDOSULFAN
II GLOBE CHEMICALS, S.A. DE C.V.	ENDOSULFAN TECNICO 94%	ENDOSULFAN
II GOWAN MEXICANA, S.A.P.I. DE C.V.	GOWAN ENDOSULFAN 50 PH	ENDOSULFAN
II GOWAN MEXICANA, S.A.P.I. DE C.V.	GOWAN ENDOSULFAN 3 CE / ENDOX 360 CE / PROSULFAN 3 CE / AGROPULL 360 CE	ENDOSULFAN
II GOWAN MEXICANA, S.A.P.I. DE C.V.	ENDOSULFAN TECNICO	ENDOSULFAN
II INDUSTRIAS AGRICOLAS, S.A. DE C.V.	ENDOSULFAN TECNICO	ENDOSULFAN
II INDUSTRIAS AGRICOLAS, S.A. DE C.V.	ENDOSULFAN 35%	ENDOSULFAN
II INGENIERIA INDUSTRIAL, S.A. DE C.V.	ALGODAN 350	ENDOSULFAN
II INSECTICIDAS DE OCCIDENTE, S.A. DE C.V.	TOXIDIAN 35%	ENDOSULFAN
II INSECTICIDAS DEL PACIFICO, S.A. DE C.V.	ENDOFAN 35%	ENDOSULFAN
II INSECTICIDAS NACIONALES COREY, S.A. DE C.V.	ENDOCORAL 35% C.E.	ENDOSULFAN
II KOOR INTERCOMERCIAL, S.A.	THIONEX TECNICO / VELDOSULFAN TECNICO	ENDOSULFAN

continued next page

COMPANY	COMMERCIAL NAME	ACTIVE INGREDIENT
II KOOR INTERCOMERCIAL, S.A.	THIONEX 350 EC / MANTIS 350 CE / THIONEX 350 CE / ENDOSULFAN 350 CE / BRAGADO 350 CE /	ENDOSULFAN
II MAKHTESHIM-AGAN DE MEXICO, S.A. DE C.V.	THIONEX TECNICO	ENDOSULFAN
II MELESIO HECTOR CARDENAS MENDOZA Y/O AGROCAR	THIOCAR 35	ENDOSULFAN
II MEZCLAS Y FERTILIZANTES, S.A. DE C.V.	PODEROSO 35 C.E.	ENDOSULFAN
II NACIONAL AGROQUIMICA, S.A. DE C.V.	NASADAN 35	ENDOSULFAN
II NAYCHEM, S.A. DE C.V.	ENDOSULFAN 35 E	ENDOSULFAN
II PETRO DE OCCIDENTE, S.A. DE C.V.	AGROFAN 35 CE	ENDOSULFAN
II PLAGUICIDAS MEXICANOS, S.A. DE C.V.	PLAGUI-DAN 35%	ENDOSULFAN
II POLAQUIMIA, S.A. DE C.V.	ENDOPOL	ENDOSULFAN
II POLAQUIMIA, S.A. DE C.V.	ENDOPOL	ENDOSULFAN
II POLISULFUROS DE MEXICO, S.A. DE C.V.	THIOSUL 35	ENDOSULFAN
II PROAGRO DEL NOROESTE, S.A. DE C.V.	PRONEX 35% / THIOJAM 35 / ASPEN 35 / COUCH 35 / FANCY 35 / FANG 35	ENDOSULFAN
II PRODUCTOS BASICOS, S.A. DE C.V.	ENDOSULFAN 35 %	ENDOSULFAN
II PROMOTORA DE TECNICA AGROPECUARIA, S.A. DE C.V.	ENDOSULFAN 95% TECNICO	ENDOSULFAN
II PROVEEDORA AGRICOLA LAGUNERA, S.A. DE C.V.	ENDOSULFAN 35	ENDOSULFAN
II PROVINDUSTRIAS DE OCCIDENTE, S.A. DE C.V.	POSULFAN 35	ENDOSULFAN
II PYOSA, S.A. DE C.V.	DESTROY/PANTHER	ENDOSULFAN
II QUIMICA AGRICOLA DEL VALLE DE CULIACAN, S.A. DE	THIO-VAC	ENDOSULFAN
II QUIMICA AGRICOLA DEL VALLE DE CULIACAN, S.A. DE	THIO-VAC 35-F	ENDOSULFAN
II QUIMICA LUCAVA, S.A. DE C.V.	LUCASULFAN TECNICO	ENDOSULFAN
II QUIMICA LUCAVA, S.A. DE C.V. INDETERMINADA	LUCASULFAN 35 C.E. / METEORO 35 CE / ENDOSULFAN QL 35 CE / FARFAN 35 CE / STEEL 35 CE	ENDOSULFAN
II QUIMICA SAGAL, S.A. DE C.V.	MISULFAN / AGROSULFAN / AGRISULFAN	ENDOSULFAN
II QUIMICAL, S.A. DE C.V.	ENDOSULFAN 35 E	ENDOSULFAN
II RHONE POULENC AGRO, S.A. DE C.V.	ENDOSULFAN TECNICO	ENDOSULFAN
II SEMILLAS DEL PACIFICO, S.A. DE C.V.	ENDOSULFAN 378	ENDOSULFAN
II SINTESIS Y FORMULACIONES DE ALTA TECNOLOGIA, S.A.	THIOFIXAN TECNICO	ENDOSULFAN
II SINTESIS Y FORMULACIONES DE ALTA TECNOLOGIA, S.A.	THIOFIXAN / METEORO / ENDOFAN 350 / ATSASULFAN	ENDOSULFAN
II TECNICA AGRICOLA CHIAPAS, S.A. DE CV	TACSAFAN	ENDOSULFAN
II UNITED PHOSPHORUS DE MEXICO, S.A. DE C.V	USULFAN TECNICO / ENDOSULFAN TECNICO	ENDOSULFAN
II UNITED PHOSPHORUS DE MEXICO, S.A. DE C.V	USULFAN 35% EC / TIOKIL 35 / ENDOKILL / POLICIA	ENDOSULFAN
II VAMEX DE LOS MOCHIS S.A.DE C.V.	ENDOSULFAN 35 %	ENDOSULFAN
II VELSIMEX, S.A. DE C.V.	VELDOSULFAN 35 C.E. / ENDOSTAR 35 CE / AGRISULFAN 35 CE / DOFAN 35 CE / TOPSULFAN 35	ENDOSULFAN
III BAYER DE MEXICO, S.A. DE C.V.	SEVIDAN 70 P.H.	CARBARILO + ENDOSULFAN
III BAYER DE MEXICO, S.A. DE C.V.	THIODAN 26 CS / THIODAN ULTRACAPS	ENDOSULFAN
III PROVEEDORA AGROINDUSTRIAL DE SINALOA, S.A. DE	ENDOS 35	ENDOSULFAN
III VELSIMEX, S.A. DE C.V.	ENDOSULFAN TECNICO	ENDOSULFAN
IV NAYCHEM, S.A. DE C.V.	ENDOSULFAN 4 %	ENDOSULFAN
IV PLAGUICIDAS MEXICANOS, S.A. DE C.V.	PLAGUI-DAN 4% POLVO	ENDOSULFAN
IV QUIMICA LUCAVA, S.A. DE C.V.	LUCASULFAN 4% P	ENDOSULFAN

source: REGISTROS DE PLAGUICIDAS AUTORIZADOS POR CATEGORIA TOXICOLOGICA
http://www.cofepris.gob.mx/work/sites/cfp/resources/LocalContent/785/8/regplag.pdf
download: 22/04/2011

Annex 6. Registered endosulfan products in Australia 1998. Source NRA, 1999.

Product Name	Applicant
Campbell Endosulfan 350 EC Insecticide	Colin Campbell (Chemicals) Pty Ltd
Endosan ULV Insecticide	Crop Care Australasia Pty Ltd
Endosan Emulsifiable Concentrate Insecticide	Crop Care Australasia Pty Ltd
Davison Endosulfan 350 EC Insecticide	Davison Industries Pty Ltd
Davison Endosulfan 250 ULV Insecticide	Davison Industries Pty Ltd
Farm-oz Endosulfan 240 ULV Insecticide	Farmoz Chemicals Pty Ltd
Farm-oz Endosulfan 350 EC Insecticide	Farmoz Chemicals Pty Ltd
Thiodan ULV Insecticide	Hoechst Schering AgrEvo Pty Ltd
Thiodan Insecticide	Hoechst Schering AgrEvo Pty Ltd
Thiodan EC Insecticide	Hoechst Schering AgrEvo Pty Ltd
Thionex 350 EC Insecticide Spray	Makhteshim-Agan (Aust) Pty Ltd
Nufarm Endosulfan ULV 240 Insecticide	Nufarm Ltd (Laverton)
Nufarm Endosulfan 350 EC Insecticide	Nufarm Ltd (Laverton)
350 EC Bar Insecticide by Sanonda	Sanonda (Australia) Pty Ltd
240 ULV Bar Insecticide by Sanonda	Sanonda (Australia) Pty Ltd

Substance	Registrant	Approval holder	Approval number
Endosulfan	Farmoz Pty Ltd	E.I.D. Parry (India) Limited Thane-Belapur Road Thane Maharashtra State INDIA	44288
Endosulfan	Hoechst Schering AgrEvo Pty Ltd	Hoechst Schering AgrEvo GmbH Werk Greisheim Stroofstrasse 27 D65933 Frankfurt am Main GERMANY	44305
Endosulfan	Makhteshim-Agan (Australia) Pty Ltd	Makhteshim Chemical Works Ltd New Industrial Estate Beer-Sheva 84100 ISRAEL	44093
Endosulfan	Pivot Limited	Excel Industries Ltd 6/2 Ruvapari Road Bhavnagar - 364001 Bombay 4000102 INDIA	44012

Annex 7. Registered endosulfan products in Australia 2010. Above active ingredients approvals for endosulfan, below registered products containing endosulfan. Source gazette_2010-10-12_page_19_australia.pdf

Approval Number	Approval Holder
44012	EXCEL INDUSTRIES (AUSTRALIA) PTY LTD
44093	FARMOZ PTY LIMITED
57040	IMTRADE AUSTRALIA PTY LTD

Product Number	Product Name	Registrant	Label Approval Numbers
32799	NUFARM ENDOSULFAN 350 EC INSECTICIDE	NUFARM AUSTRALIA LIMITED	32799/060532799/060632799/0705
50004	THIODAN EC INSECTICIDE	BAYER CROPSCIENCE PTY LTD	50004/0805
52163	FARMOZ ENDOSULFAN 350 EC INSECTICIDE	FARMOZ PTY LIMITED	52163/090552163/090652163/1109
61503	KENSO AGCARE ENDO 350 EC INSECTICIDE	KENSO CORPORATION (M) SDN. BHD.	61503/061061503/0709
64421	FARMALINX ENDOSULFAN INSECTICIDE	FARMALINX PTY LTD	64421/0909

Annex 8. Export from various Indian ports, period September 2003 – October 2004.

Date	HS Code	Product Description	Qty.	Unit	India Port	Foreign Port	Foreign Country
1-9-2003	38081031	A1625 endosulfan formulation (agrochemical)	15000	Ltr	Jnpt	Montevideo	Uruguay
16-9-2003	38081031	Endosulfan technical pkg:300 fibre board drum x 50 kgs mfgr.excel crop care ltd.g ujrat	15000	Kgs	Jnpt	Bangkok	Thailand
17-9-2003	38081031	Endosulfan 35%w/w pkg box x 20 bottles x 1 liter each mfgr.excel crop carr ltd ga jarat is/iso 9002:	12000	Ltr	Jnpt	Lagos	Nigeria
6-10-2003	38081031	Endosulfan 35% w/w pkg.box x 20 bottles x 1 litre each.	12000	Ltr	Jnpt	Tincan/lagos	
7-10-2003	38081031	A1624 endosulfan technical 95 percent mi n	8000	Kgs	Jnpt	Port klang	Malaysia
27-10-2003	38081031	Endosulfan(technical) pkg:480 bgs x 25 kgs each	12000	Kgs	Jnpt	Tpt bangkok	
28-10-2003	38081031	Endosulfan (technical) pkg:320 bag x 25 kgs each a/c. zagro singapore pte ltd za gro global hub 5 w	8000	Kgs	Jnpt	Port klang	Malaysia
11-11-2003	38081031	Endosulfan (technical)pkg.:net 50kgs in un approved fibre board drum.	15000	Kgs	Jnpt	Bangkok	Thailand
12-11-2003	38081031	Endosulfan (technical) pkg:800 bags x 25 kgs each	20000	Kgs	Jnpt	Tpt,bangkok	
25-11-2003	38081031	Endosulfan	280	Kgs	Cochin sea	Brazil	Brazil
28-11-2003	38081031	Endosulfan 35% w/w	16000	Ltr	Jnpt	Montevideo	Uruguay
29-12-2003	38081031	A-1624 technical grade pesticide endosulfan technical	5000	Kgs	Jnpt	Santos, brazil	
29-12-2003	38081031	Endosulfan (technical)pkg.:200drms 50kgs in un approved fibre board drum.	10000	Kgs	Jnpt	Penang	Malaysia
1-1-2004	38081031	Endosulfan (technical)	20000	Kgs	Jnpt	Paranagua	Brazil
8-1-2004	38081031	A-1624 agricultural insecticides endosulfan formulation 1140ctns (endosul fan 35 ec) pkg;(1	11400	Ltr	Jnpt	Port lagos	
9-1-2004	38081031	A 1625 endosulfan formulation (agrochemical)	5000	Ltr	Jnpt	Antwerpen	
14-1-2004	38081031	(a-1624)endosulfan (technical)pkg:800 bag x 25 kg each	20000	Kgs	Jnpt	Ashdod	Israel
23-2-2004	38081031	Endosulphan technical	18602	Kgs	Bombay sea	China	China
25-2-2004	38081031	Endosulfan	280	Kgs	Cochin sea		
25-2-2004	38081031	A 1609 chlorpyriphos tech 98%min	8000	Kgs	Jnpt	Limassol	Cyprus
28-2-2004	38081031	Endosulfan (technical) (agrochemical)	2000	Kgs	Jnpt	Durban	South africa
28-2-2004	38081031	Endosulfan (technical) (agrochemical)	12000	Kgs	Jnpt	Buenos aires	Argentina
28-2-2004	38081031	Endosulfan (technical) (agrochemical)	3000	Kgs	Jnpt	Rotterdam	Netherlands
1-3-2004	38081031	A-1624 endosulfan 50% w.p.pkg.:un approved 25 kgs paper bags on pallets.mf gr:hyderabad chemi	11000	Kgs	Jnpt	Antwerp	Belgium
3-3-2004	38081031	Endosulfan (technical)pkg.:80 net 50kgs in un approved fibre board drum	4000	Kgs	Jnpt	Lisbon	Portugal
4-3-2004	38081031	A-1624 endosulfan (technical) pkg.:150 drum x 100 kgs	15000	Kgs	Jnpt	Brisbane	Australia
8-3-2004	38081031	Endosulfan (technical)pkg:800 bag x 25 kgs each	20000	Kgs	Jnpt	Damietta	Egypt
8-3-2004	38081031	Endosulfan (technical)pkg:net50kgs in un approved fibre board drums	15000	Kgs	Jnpt	Buenos aires	Argentina
10-3-2004	38081031	Endosulfan (technical) pkg:net 50kgs un approved fibre board drum	15000	Kgs	Jnpt	Istanbul	Turkey
16-3-2004	38081031	A1624 endosulfan technical packing 40 ms drum(50 kg each)	2000	Kgs	Jnpt	Santo tomas de castilla	Guatemala
18-3-2004	38081031	Endosulfan(technical)	20000	Kgs	Jnpt	Ho chi minh city	Vietnam, democratic rep.
18-3-2004	38081031	Endosulfan (technical)pkg:net50kgs in un approved fibre board drum	15000	Kgs	Jnpt	Barcelona	Spain
26-3-2004	38081031	A1609 endosulfan (technical)	15000	Kgs	Jnpt	Veracruz	Mexico
19-4-2004	38081031	Endosulfan formulation	3060	Kgs	Madras sea		Lebanon
29-6-2004	38081031	Endosulfan 35% ec sion sr no :a-1624 packing:100 corrugated boxes of 10 alumi nium bottles of 1l	1000	Ltr	Bombay sea	Harare	Zimbabwe
25-7-2004	38081031	Endosulfan tech.	14000	Kgs	Cochin sea		Brazil
8-10-2004	38081031	Endosulfan (technical)	6000	Kgs	Bombay sea	Jebel ali	United arab emirats
18-10-2004	38081031	Endosulfan (technical) sion sr.no.a 1624	15000	Kgs	Bombay sea	Bandar abbas	Iran
19-10-2004	38081031	Endosulfan (technical)	15000	Kgs	Bombay sea	Buenos aires	Argentina
27-10-2004	38081031	Endosulfan (technical)	30000	Kgs	Bombay sea	Ho chi minh city	Vietnam, democra
22-8-2003	38019000	A-1625 endosulfan formulation packed in 1 ltr btls.again 10 bttls.pkd.in 1 bo x	7000	Ltr	Bombay air	Apapa sea port	
20-5-2003	38019000	Endosulfan technical packed in 25 kgs. bags	2000	Kgs	Jnpt	Genoa	Italy
9-10-2003	38081011	A-1624 endosulfan (technical) (agrochemical)	5000	Kgs	Jnpt	Antwerp	Belgium
1-1-2004	38081011	Endosulfan technical	45000	Kgs	Jnpt	Bandar abbas	Iran
4-3-2004	38081011	Endosulfan 35% ec	32760	Ltr	Madras sea	Miami	United states
16-1-2004	38081011	Endosulfan technical	38600	Kgs	Jnpt	Bandar abbas	Iran
28-8-2003	38081099	Endusulfan (technical)packing : 25 kgs each bag	14000	Kgs	Bombay air	Barcelona	Spain
7-10-2003	38081099	Endosulfan(technical)	15000	Kgs	Jnpt	Lat krabang	
20-9-2003	38081099	Endosulfan(technical)	20000	Kgs	Jnpt	Haiphong	Vietnam
15-12-2003	38081099	Endosulfan 35% w/w	16000	Ltr	Jnpt	Montevideo	Uruguay
3-12-2003	38081099	Endosulfan (technical)	20000	Kgs	Jnpt	Ashdod	Israel
1-10-2003	38081099	Endosulfan(technical)(a1624)	40000	Kgs	Jnpt	Paranagua	Brazil
31-12-2003	38081099	Endosulfan (technical)(agrochemical)	20000	Kgs	Jnpt	Veracruz	Mexico

Export of endosulfan from Indian ports between 01/09/2003 and 27/10/2004 under HS-code 38081031 - Endosulfan, technical grade and other codes. Note that the export of 16/09/2003 to Bangkok and 20/09/2003 to Haiphong can also be found in the annex 9.
Sources:

Annex 9. Export from various Indian ports, period September 2003.

TC-HS Code	Item Description	QTY	Unit	Value	Rate	Exporter's Name	Country	Port	Mode	Date
38081011	ENDOSULFAN(TECHNICAL)	45000	KGS	8785342,5	195.23	EXCEL CROP CARE LIMITED	Lat Krabang	JNPT	S	24-9-2003
38081001	ENDOSULFAN	31200	LTR	4891316	156.77		CI	Madras	S	25-7-2003
38081099	ENDOSULFAN (TECHNICAL) (AGROCHEMICAL)	20000	KGS	4244359,88	212.22	BUBNA ENTERPRISES	Buenos Aires	JNPT	S	3-9-2003
38081031	A-1624 ENDOSULFAN (TECHNICAL) (AGROCHEMICAL)	20000	KGS	4180449,88	209.02	BUBNA ENTERPRISES	Buenos Aires	JNPT	S	18-9-2003
38081017	ENDOSULFAN (TECHNICAL)	20000	KGS	3998940	199.95	EXCEL CROP CARE LIMITED	Bangkok	JNPT	S	27-9-2003
38081099	ENDOSULFAN(TECHNICAL)	20000	KGS	3770690	188.53	EXCEL CROP CARE LIMITED	Haiphong	JNPT	S	20-9-2003
38081031	A1624 ENDOSULFAN(TECHNICAL) (AGROCHEMICAL)	16000	KGS	3361359,69	210.08	BUBNA ENTERPRISES	Buenos Aires	JNPT	S	26-9-2003
38081099	ENDOSULFAN(TECHNICAL)(	15000	KGS	3105392,38	207.03	BUBNA ENTERPRISES	Buenos Aires	JNPT	S	12-9-2003
38081031	ENDOSULFAN TECHNICAL PKG:300 FIBRE BOARD DRUM X 50 KGS MFGR.EXCEL CROP CARE LTD.G UJRAT	15000	KGS	2925503,08	195.03	EXCEL INDUSTRIES LTD	Bangkok	JNPT	S	16-9-2003
38081017	ENDOSULFAN (TECHNICAL)	15000	KGS	2921600	194.77	EXCEL CROP CARE LIMITED	TPT Bangkok	JNPT	S	27-9-2003
38081011	ENDOSULFAN TECHNICAL	15000	KGS	2855407,5	190.36	E.I.D. PARRY (INDIA)	Bangkok	JNPT	S	
38081017	ENDOSULFAN (TECHNICAL)	15000	KGS	2830300	188.69	EXCEL CROP CARE LIMITED	Antwerp	JNPT	S	27-9-2003
38081011	ENDOSULFAN TECHNICAL	15000	KGS	2821170	188.08	E.I.D. PARRY (INDIA)	Bangkok	JNPT	S	25-9-2003
38081011	ENDOSULFAN TECHNICAL	15000	KGS	2798345	186.56	E.I.D. PARRY (INDIA)	PECEM	JNPT	S	15-9-2003
38081011	ENDOSULFAN TECHNICAL	15000	KGS	2798345	186.56	E.I.D. PARRY (INDIA)	PECEM	JNPT	S	12-9-2003

Lat Krabang Port, Thailand; CI, Chili; Buenos Aires, Argentina; Bangkok, Thailand; Haiphong, Vietnam; Antwerp, Belgium; PECEM, Brazil
JNPT = Jawaharlal Nehru Port, Maharasthra. Access to neighbouring Mumbai and to the hinterland of Maharashtra, Madhya Pradesh, Gujarat, Karnataka and most of North India. Madras = Chennai. Source: http://www.planetexim.net/eximinfo/Export/Chapter-38.rtf Download 15/02/2011.

Annex 10. PIC CIRCULAR XXX – December 2009. Notifications of final regulatory action for chemicals not included in Annex III Appendix V verified to meet the requirements of Annex I. Source: Rotterdam Convention, http://www.pic.int/en/Circular/CIRC-30-En.pdf, download 13/04/2011.

chemical name	CAS number	Category	Country	Region	Circular
Endosulfan	115-29-7	Pesticide	Saudi Arabia	Near East	no
Endosulfan	115-29-7	Pesticide	Burkina Faso	Africa	XXVIII
Endosulfan	115-29-7	Pesticide	Cape Verde	Africa	XXVIII
Endosulfan	115-29-7	Pesticide	Côte d´Ivoire	Africa	XX
Endosulfan	115-29-7	Pesticide	European Community	Europe	XXIV
Endosulfan	115-29-7	Pesticide	Gambia	Africa	XXVIII
Endosulfan	115-29-7	Pesticide	Guinea-Bissau	Africa	XXIX
Endosulfan	115-29-7	Pesticide	Iran (Islamic Republic of)	Asia	XXX
Endosulfan	115-29-7	Pesticide	Jordan	Near East	XVIII
Endosulfan	115-29-7	Pesticide	Malaysia	Asia	XXX
Endosulfan	115-29-7	Pesticide	Mali	Africa	XXVIII
Endosulfan	115-29-7	Pesticide	Mauritania	Africa	XXVIII
Endosulfan	115-29-7	Pesticide	Netherlands	Europe	XII
Endosulfan	115-29-7	Pesticide & Industrial chemical	New Zealand	Southwest Pacific	XXIX
Endosulfan	115-29-7	Pesticide	Niger	Africa	XXVIII
Endosulfan	115-29-7	Pesticide	Norway	Europe	XIII
Endosulfan	115-29-7	Pesticide	Senegal	Africa	XXVIII
Endosulfan	115-29-7	Pesticide	Thailand	Asia	XXI

Notifications of final regulatory action that have been received by the Secretariat but for which the verification process has not yet been completed. Saudi Arabia

Annex 11. Information on use in various Parties to the Convention. Empty cells indicate that there was no information available.

Participant	use	banned since
Albania	forbidden	
Algeria	in use	
Angola		
Antigua and Barbuda		
Argentina	authorised/in use	phase out in 2012
Armenia		
Australia	authorised	2 yr phase out since oct 2010
Austria	banned	since 2007
Azerbaijan		
Bahamas		
Bahrain	banned	
Bangladesh	in use	
Barbados		
Belarus		
Belgium	banned	since 2007
Belize	banned	since 1995
Benin	banned	since 2008
Bolivia	in use	
Bosnia and Herzegovina		
Botswana		
Brazil	authorised, 2010	phase out by 2013
Brunei Darussalam		
Bulgaria	banned	since 2000
Burkina Faso	banned	since December 2008
Burundi	data not available	
Cambodia	banned	since 2003
Cameroon		
Canada	authorised	phase out per 2016
Cape Verde	banned	since December 2008
Central African Republic		
Chad	banned	since December 2008
Chile	in use	
China	authorised	
Colombia	banned	since 2002
Comoros		
Congo, Democratic Republic of the	in use	
Congo, Republic of the		
Cook Islands		
Costa Rica	severely restricted	
Côte d´Ivoire	banned	
Croatia	banned	since 2007
Cuba		
Cyprus	banned	since 2001
Czech Republic	banned	since 2001
Denmark	banned	
Djibouti		
Dominica	severely restricted	
Dominican Republic	in use	

Participant	use	banned since
Ecuador	authorised/in use	
Egypt	banned	
El Salvador		
Eritrea		
Estonia	not registered	never used
Ethiopia	authorised	
European Union	banned	since 2007
Fiji		
Finland	banned	since 2001
France	banned	since 2007
Gabon		
Gambia	banned	since December 2008
Georgia		
Germany	banned	since 1991
Ghana	banned	since 2008
Greece	banned	since 2007
Guatemala	authorised (?)	
Guinea	authorised	
Guinea-Bissau	banned	since December 2008
Guyana	authorised	at least in 2008
Haiti		
Honduras	authorised	
Hungary	banned	since 2007
Iceland	not registered	temp exemp. 1994-1996
India	authorised	
Indonesia	banned	
Iran (Islamic Republic of)	banned	since 2010
Ireland	banned	since 2002
Israel	authorised	no use data
Italy	banned	since 2002
Jamaica	not authorised	
Japan	in use	announced phase out
Jordan	banned	since 1994
Kazakhstan		
Kenya		
Kiribati		
Korea, Democratic People´s Republic of		
Korea, Republic of	severely restricted	announced phase out
Kuwait	banned	
Kyrgyzstan		
Lao People´s Democratic Republic		
Latvia	not registered	
Lebanon		
Lesotho		
Liberia		
Libyan Arab Jamahiriya		
Liechtenstein	banned	
Lithuania	banned	
Luxembourg	banned	since 2007

Participant	use	banned since
Madagascar	authorised	
Malawi	authorised	
Malaysia	banned	since 2005
Maldives		
Mali	banned	since December 2008
Malta	banned	
Marshall Islands		
Mauritania	banned	since December 2008
Mauritius	banned	
Mexico	authorised	
Micronesia (Federated States of)		
Moldova, Republic of		
Monaco	not used	
Mongolia		
Montenegro		
Morocco	in use	
Mozambique	in use	
Myanmar	in use (see remark)	
Namibia		
Nauru		
Nepal		
Netherlands	banned	since 1990
New Zealand	banned	effective January 16, 2009
Nicaragua		
Niger	banned	since December 2008
Nigeria	banned	since 2007 moratorium
Niue		
Norway	banned	since 1999
Oman	banned	
Pakistan	in use	
Palau		
Panama	authorised	
Papua New Guinea		
Paraguay	in use	phase out in 2012
Peru	authorised	
Philippines	severely restricted	since 1993, but exemptions in 19
Poland	not included	since 2007
Portugal	banned	since 2007
Qatar	banned	
Romania	banned	currently
Russian Federation		
Rwanda		
Saint Kitts and Nevis		
Saint Lucia	banned	
Saint Vincent and the Grenadines		
Samoa		
Sao Tome and Principe		
Saudi Arabia	banned	
Senegal	banned	since December 2008

Participant	use	banned since
Serbia	banned	phased out since 2009
Seychelles		
Sierra Leone		
Singapore	banned	since 1984
Slovakia	banned	
Slovenia	banned	since 2009/10
Solomon Islands		
Somalia		
South Africa	in use	
Spain	banned	since 1995
Sri Lanka	banned	since 1998
Sudan	authorised	
Suriname		
Swaziland		
Sweden	banned	since 1995
Switzerland	not registered	since 2009
Syrian Arab Republic	banned	
Tajikistan		
Tanzania, United Republic of	authorised	
Thailand	severely restricted (2004)	
The former Yugoslav Republic of Mace	in use	
Togo	authorised	
Tonga		
Trinidad and Tobago		
Tunisia	not registered	
Turkey	in use	
Tuvalu		
Uganda	authorised	
Ukraine	not registered	since 1996
United Arab Emirates	banned	
United Kingdom of Great Britain and N	banned	since 2007
United States of America	authorised	phase out by 2016
Uruguay	authorised	since 1968
Vanuatu		
Venezuela (Bolivarian Republic of)	severely restricted	
Viet Nam	in use	
Yemen		
Zambia	authorised	
Zimbabwe		

Registered/in use:	40 (of which 8 will phase out: Argentina, Australia, Brazil, Canada, Japan, Paraguay, Republic of Korea and United States)
severely restricted:	6
banned:	70

Annex 12. Registered products containing endosulfan in Argentina, 2011

Active ingredient	Product	Company
Endosulfan	Refugio	Agroservicios Pampeanos S.A.
Endosulfan	Alfasan 35	Alfalfares S.R.L.
Endosulfan	Araendo 35	Aranami S.A.
Endosulfan	Endosulfan ACA 35	Asociacion Cooperativas Arg. Coop. Ltd
Endosulfan	Nezaran 35 ACA	Asociacion Cooperativas Arg. Coop. Ltd
Endosulfan	Endosulfan Atanor 35	Atanor S.C.A.
Endosulfan	Thiodan 35 EC	Bayer S.A.
Endosulfan	Phaser	Bayer S.A.
Endosulfan	Endosulfan Bisterfeld	Bisterfeld Argentina S.A.
Endosulfan	Endosulfan Brometan	Brometan S.R.L.
Endosulfan	Endosulfan Caisa	Caisa S.R.L.
Endosulfan	Camposulfan 35	Campo Crop S.A.
Endosulfan	Mortero 35 %	Cia Arg.De Semillas S.A.
Endosulfan	Zebra Ciagro	Ciagro S.A.
Endosulfan	Zebra	Ciagro S.R.L.
Endosulfan	Endosur	Cuenca Sur S.A.
Endosulfan	Master	Chemiplant S.A.
Endosulfan	Galgofan	Chemotecnica S.A.
Endosulfan	Galgotal	Chemotecnica S.A.
Endosulfan	Hexulfan	Chimagro S.A.
Endosulfan	Endosulfan Agar Cross	DuPont Argentina S.A.
Endosulfan	FCM Endosulfan	Felix Menendez S.R.L.
Endosulfan	Endosulfan-FQ	Fitoquim S.A.
Endosulfan	Endosulfan 35 Formulagro	Formulagro S.R.L.
Endosulfan	Endosulfan 35 Glex	Gleba S.A.
Endosulfan	Endosulfan 35	Gleba S.A.
Endosulfan	Vycsulfan	Gleba S.A.
Endosulfan	Endosulfan Brometan	Gleba S.A.
Endosulfan	Thiosulfax 35	Icona S.A.
Endosulfan	Ishisulfan	Insumos Agroquimicos S.A.
Endosulfan	Endodegser	Laboratorios Degser S.R.L.
Endosulfan	Endosulfan LQ 35	Lanther Quimica S.A.
Endosulfan	Thionex-L	Magan Argentina S.A.
Endosulfan	Thionex 50 PM	Magan Argentina S.A.
Endosulfan	Thionex	Magan Argentina S.A.
Endosulfan	Endomark	Markman Saul Enrique
Endosulfan	Endosulfan 35 Melthis	Melthis S.A.
Endosulfan	Endosulfan 35 TF Zamba	Nidera S.A.
Endosulfan	Endosulfan 35 Nitrap	Nitrap S.R.L.
Endosulfan	Endosulfan 35 Desab	Nitrap S.R.L.
Endosulfan	Endosulfan 35 Nitrasoil	Nitrasoil Argentina S.A.
Endosulfan	Endosulfan 35 Nufarm	Nufarm S.A.
Endosulfan	Endofan 35	Osvaldo Fantini Y Cia S.R.L.
Endosulfan	Endosulfan Quebrachito	Quebrachito Granos S.A.
Endosulfan	Daargussulfan	Reopen S.A.
Endosulfan	Endosulfan Activo	Reposo S.A.I.C.
Endosulfan	Endosem 35	Sembrado S.A.
Endosulfan	Endosulfan La Tijereta	Seminium S.A.
Endosulfan	Vendaval Endosulfan 35 E	Sintesis Quimica S.A.I.C.
Endosulfan	Endosulfan Terrium	Terrium Argentina S.A.
Endosulfan	Endotex 35	Tex Argentina S.R.L.
Endosulfan	Endosulfan Triavet	Triavet S.A.
Endosulfan	Triavet Endosulfan	Triavet S.A.
Endosulfan + Cypermethrin	Xiper plus	Icona S.A.

source: Asociacion Argentina de Proteccion vegetal y ambienal
http://www.asaprove.org.ar/agroquimicos.php?pg=12
download 19/03/2011

Annex 13. Data on the restriction and phase out of endosulfan in various countries as provided by UN (2002) and UN (2009).

UNEP, 2002 Country	Effective date	Description of action taken Grounds for decision
Belize	28 Dec 1995	Endosulfan is a prohibited pesticide it shall not be brought into or used in Belize. Its possible effects on the environment, plants, animals or human beings are considered to be too dangerous to justify its use. Reference: (BLZPC) Pesticides Control No. 32.87. 1985
Canada		Registered for commercial use only. 'Commercial' refers to use by operators engaged in commercial pest control, not consumer use in and around home. (Reference: (UNEP) UNEP/FAO - PIC Circular X - 12/1999...)
Canada		Registered for commercial use only. 'Commercial' refers to use by operators engaged in commercial pest control, (i.e. not consumer use in and around home). (Reference: (UNEP) UNEP/FAO - PIC Circular X - 12/1999...)
Dominica		Severely restricted pesticide. (Reference: (DMAPC) Pesticide Control Board… 1985)
Denmark		Considered to be a severely restricted pesticide by authorities. Approved for very specific uses
Finland	1 Mar 1984	Use as a pesticide severely restricted. The chemical can be sold only to professionals who have a special permission given by the authorities. It may be used on gooseberry and currant-bushes until one week after the flowering, on strawberry plants after the harvest and in nurseries for garden plants. No other uses are allowed. High risk to human health and the environment, e.g. bioaccumulation. (Reference: (UNEP) UNEP/FAO - PIC Circular X - 12/1999...)
Hungary		May be used only in agriculture where its proper application is ensured by the presence of trained staff and protective equipment
Korea, Republic of	25 Feb 1981	Classified as a 'highly hazardous' and 'restricted use' pesticide. Due to high toxicity to fish and shellfish, the use in rice paddy is strictly prohibited. Pre-harvest intervals were established for the safe use of this product. Action taken because of high acute toxicity and high toxicity to fish. (Reference: (UNEP) UNEP/FAO - PIC Circular X - 12/1999...)
Korea, Republic of	9 Aug 1991	Banned for production, import, use, and safe of both this substance and preparations containing it. Permitted in agricultural chemicals. Action taken due to fish toxicity. (Reference: (UNEP) UNEP/FAO - PIC Circular X - 12/1999...)
Kuwait	1 June 1993	Severely restricted. Remaining use allowed in granules as soil insecticides. Remaining use constitutes a minor part of previously allowed or possible uses. Action was taken for health and environmental reasons. (Reference: (UNEP) UNEP/FAO - PIC Circular X - 12/1999...)
The Netherlands	27 Nov 1989	Endosulfan is banned. No uses remaining. Harmful to the environment. (Reference: (NETMAF) Decree of the Ministry of Agriculture and Fisheries. Ministerial Order…. 1989)
Norway	1 Jan 1999	Endosulfan is banned. No uses remaining. Endosulfan has a low LD50 and is thus characterised as toxic. Endosulfan has high persistence in soil, is extremely toxic to fish and toxic to bees. Some cases of intoxication among workers. (Reference: (DESC) (UNEP) UNEP/FAO - PIC Circular X, XI, XII - 6/2000, 12/2000, 6/2001...)
Philippines		Prohibited for use near aquatic ecosystems

Singapore	Apr 1984	Importation and sale for local use is banned. This decision was taken to safeguard water sources
Venezuela	1983	The preparation, import, export, storage, purchase, sale and distribution of organochlorine insecticides shall be permitted only when they are intended for the following uses: Legislative or regulation action Control of vectors for medical reasons, provided their application is carried out by the Ministry of Health and Social Welfare or under it s technical advice and supervision. 2. Control of agricultural pests, provided that the situation is an emergency one and that their application is carried out or directed by the Ministry of Agriculture and Stock raising. 3. control of *Atta sexdens* and other ants, exclusively with granulated formulations containing aldrin and chlordane and in applications going directly on to the soil. 4. control of termites in formulations containing aldrin and chlordane. Organochlorine compounds pollute the environment and, owing to the persistence of residues in foodstuffs of animal and vegetable origin, are a cause of concern to public health. (Reference: (GOVEN) Gaceta Oficial de la Republica de Venezuela 247. 270 .. 1983)
Serbia	1972	Its use in agriculture is severely restricted so that it may not be used on tobacco, forage plants, nor on areas where the danger exists of contaminating water or poisoning animals. The restriction was imposed because endosulfan proved harmful to human health and to useful organisms and also because it does not disintegrate readily in the soil, in plants and in animals, and it noxiously affects the biocenosis.

UNEP, 2009		
European Union	02 June 2006	The chemical is banned. All the applications as plant protection products, except the essential uses listed in the final regulatory action. (Reference: (EP6) UNEP/FAO - PIC Circulars XXI, XXII, XXIII, XXIV - 6/2005, 12/2005, 6/2006, 12/2006, , ,)
Cote d'Ivoire	01 Jan 1998	The chemical is banned. It is a registered chemical but its use is severely restricted and is controlled by ANADER (National Agency for Rural Development Aid). The product is highly toxic to humans and the environment. (Reference: (EP5) UNEP/FAO - PIC Circulars XX - 12/2004, , ,)
Thailand	19 Oct 2004	The chemical is severely restricted. All formulations are prohibited except capsule suspension (CS) formulation, which is registered for use in cotton only. (Reference: (EP6) UNEP/FAO - PIC Circulars XXI, XXII, XXIII, XXIV - 6/2005, 12/2005, 6/2006, 12/2006, , ,)

Annex 14. Use in Europe in the 1990's. Source: OSPAR, 2004

Table 3 Endosulphan consumption in Europe (metric tonnes); Source: Aventis CropScience

COUNTRY	YEAR					
	NORTHERN EUROPE [tonnes]					
	1994	**1995**	**1996**	**1997**	**1998**	**1999**
Belgium [2]	0	0	0	0	0	18,1
Denmark [3]	1	0	0	0	0	0
Finland [4]	3,5	0,8	0,7	1,3	0,9	0
France (north) [5]	272,6	391,9	382,8	44,7	26	28
Germany	0	0	0	0	0	0
Iceland	0	0	0	0	0	0
Ireland[6]	0,4	0,3	0,2	0,4	0,4	0
Luxembourg	0	0	0	3,8	0	0
Netherlands	0	0	0	0	0	0
Norway	1,7	1,8	0,8	0	0	0
Sweden	2	1,6	0	0	0	0
Switzerland [7]	5,7	3,9	10,9	9,9	9,8	7,6
United Kingdom	6,8	3	0	3	2,4	1
Austria	1,3	3,4	0	4,7	3	1,5
Total Northern Europe	**294,4**	**406,2**	**394,7**	**67,8**	**42,6**	**38,1**
	SOUTHERN EUROPE [tonnes]					
Portugal	6,6	5,6	5,5	0,5	0	3
Spain	235	275,5	242,9	257	314	221
France (south)	60	60	61,5	47	29,4	42,8
Italy	146,4	175	140,2	113,2	91,2	90,6
Greece	94,2	105,7	116,2	105,2	50,9	73,8
Total Southern Europe	**542,2**	**621,8**	**566,3**	**522,9**	**485,5**	**431,2**
Total Europe	**836,6**	**1028**	**961**	**590,7**	**528,1**	**469,3**

Annex 15. Phase out of endosulfan within Europe illustrated by the listing in annex I of directive 91/414/EC. As can be seen listing was already pending in 2002. Source: EU

1136 Substances (984 exist, 42	Existing/ banned/ new	Cipac	Category	FI	SE	*DK*	*IE*	*UK*	*NL*	*BE*	*LU*	*DE*	*AU*	FR	ES	PT
Endosulfan	E	0089	IN,AC	1			1	1		1	1		1	1	1	1
Endosulfan	E	0089	IN,AC	1				1		1	1		1	1	1	1
Endosulfan	E	0089	IN, AC	1				1		1	1		1	1	1	1
Endosulfan	E															

IT	*EL*	PL	*MT*	*CY*	*CZ*	*HU*	*SK*	*SI*	*EE*	*LV*	*LT*	'EU'	Aut Y/N	List	91/414 status	date
1	1											11	1	1	pending	2002
1	1			1		1		1				13			pending	2004
1	1	1		1		1		1				14	1	1	pending	2007
															out	2008

Annex 16. Registered products containing endosulfan in India, 2009.

Crop	Common name of pest	Dosage/ ha in a.i. (gm)	Formulation (gm/ml)	Waiting period (days)
Endosulfan 2% DP				
Arhar	Pod borer	500	25000	8
Gram	Pod borer	500	25000	40
	Fruit & shoot borer	500	25000	4
Brinjal	Fruit & shoot borer	500	25000	7
Endosulfan 35%				
Cotton	Jassids	210	600	70
	Aphid	210	600	70
	Thrips	280	800	70
	White fly	280	800	70
	Leaf roller	350-420	1000-1200	70
Jute	Bihar hairy caterpillar	140-175	400-500	21
	Yellow mites	175	500	21
Paddy	White jassid	175	500	21
	Stem borer	210	600	21
	Gall midge	210	600	21
	Rice Hispa	175	500	21
Maize	Aphid	175	500	21
	Stem borer	140	400	21
	Pink borer	210	600	21
Wheat	Aphid	175	500	21
	Termite	175	500	21
	Pink borer	210	600	21
Gram	Aphid	175	500	40
	Caterpillar	210	600	40
Mustard	Aphid	175	500	21
	Gall midge	263	750	21
Bhindi	Aphid	140	400	21
Chillies	Aphid	140	400	21
Tea	Aphid	288-350	750-1000	7
	Caterpillar	288-350	750-1000	7
	Helopeltis	288-350	750-1000	7
	Mealy bugs	288-350	750-1000	7
	Scale insects	288-350	750-1000	7
	Thrips	288-350	750-1000	7

continued next page

Crop	Common name of pest	Dosage/ ha in a.i. (gm)	Formulation (gm/ml)	Waiting period (days)
Endosulfan 4% DP				
Cotton	Jassids	210	5250	21
	Aphid	210	5250	21
	Thrips	280	7000	21
	White fly	280	7000	21
	Leaf roller	350-420	8750-10500	21
	Pink Boll worm	350-420	8750-10500	21
Jute	Bihar hairy caterpillar	140-175	3500-4400	21
	Yellow mites	175	4400	21
Paddy	White jassid	175	5250	21
	Stem borer	210	5250	21
	Gall midge	210	5250	21
	Rice Hispa	210	5250	21
Maize	Aphid	140-175	3500-4400	21
	Stem borer	140-210	3500-5250	21
	Pink borer	140-210	3500-5250	21
Wheat	Aphid	140-175	3500-4400	21
	Termite	140-210	3500-5250	21
	Pink borer	140-210	3500-5250	21
Gram	Aphid	140-175	3500-4400	21
	Caterpillar	140-210	3500-5250	21
	Peas semilooper	175	4400	21
Mustard	Aphid	140-175	3500-4400	21
	Gall midge	175	4400	21
Groundnut	Aphid	140-175	3500-4400	21
Bhindi	Aphid/Jassids	140-175	3500-4400	21
Onion	Aphid/Jassids	140-175	3500-4400	21
Chillies	Aphid/Jassids	140-175	3500-4400	21
Potatoes	Aphid/Jassids	140-175	3500-4400	21

source: http://cibrc.nic.in/mup.htm
download 06/04/2011

Annex 17. Insecticides recommended by the Indian Central Institute for Cotton Research for the application on cotton.

Insecticide/Formulation	Quantity (ml or g/ha)
Methomyl 25 EC	2000
Thiodicarb 75 WP	2000
Acephate 75 WP	780
Chlorpyrifos 20 EC	1250
Profenofos 50 EC	1500
Quinolphos 25 EC	2000
Triazophos 40 EC	1500
Novularon 10 EC	1000
Lufenuron 5 EC	1200
Diafenthiuron 50 WP	700
Buprofezin 25 EC	400
Pyriphroxyfen 10 EC	500
Indoxacarb 15 EC	500
Spinosad 48 EC	100
Emamectin Benzoate 5 EC	200

Source: Central Institute for Cotton Research. (2007). Know your cotton insect pest. American Bollworm. Nagpur, Maharasthra, India, Central Institute for Cotton Research. http://www.cicr.org.in/PDF/kycp_bw.pdf
Download 16/04/2011

Annex 18. Status and production of alternatives for the use of endosulfan, mainly based on information delivered for annex F information.

Alternative plant protection product (ppp) (active substance or name or type)	Crop or crop type	Pest or pest type	Information source	Year intro-duction	Manufacturors	patented or off patented	suppliers
Acetamiprid	Not specified	Not specified	India	1995	Nippon Soda Co., Ltd., Japan, Zhejiang Hisun Chemical Co. Ltd., China, (Supplier – Willowood Ltd., Hongkong), Rallis India Limited, Bangalore, M/s Gharda Chemicals, Mumbai, India	off patent in 2011 . Marketed in India by Rallis India since 2003	China (Mainland) (498) Turkey (5) Hong Kong (6) India (17) Pakistan (3) United States (3) Singapore (3) Jordan (2)
Bifenthrin EC	Cotton	-	Brazil	1984	Introduced by FMC Corp. In Brazil registrants: FMC, Milenia. Shengda Union Biochemistry Co.,Ltd. China (CN). In India: FMC Corporation, USA, FMC Asia Pacific Shangai China	off patent	China (Mainland) (175) Singapore (1) New Zealand (1) Hong Kong (2) Pakistan (1) Canada (2) United States (2) India (1)
Bifenthrin EC	soybean	anticarsia	Argentina	1984			
Buprofezin	Not specified	Not specified	India	1981	Nihan Nohyaku Co. Ltd. Tokyo, Japan, Rallis India, Coromandel Fertilisers Limited, India	off patent	China (Mainland) (195) India (4) Vietnam (4) Singapore (3) Pakistan (2) Canada (3) Hong Kong (1) South Korea (2)
Carbaryl	Not specified	Not specified	Sri Lanka	1957	Introduced by Union Carbide Corp. Aventis CropScience, now Bayer CropScience). Crystal; Drexel; Hunan Linxiang; Jin Hung; Kuo Ching; Shenzhen Jiangshan; Sundat, In India: M/s Atul Ltd., Valsad. India	off patent, US patent expired 1976	China (Mainland) (61) United States (4) Turkey (4) Israel (1) Iran (Islamic Republic of) (1) South Korea (2) Canada (2) Singapore (1) Philippines (1) India (1) Taiwan (1)
Carbaryl	soybean	small green stink bug	Argentina	1957			
Carbofuran	Not specified	Not specified	Sri Lanka	1956	Introduced by FMC Corp. and by Bayer AG.Hunan Linxiang; Jin Hung; Kuo Ching; Makhteshim-Agan; Mitsubishi Chemical; Pilarquim; Sanachem; Shenzhen Jiangshan; Sinon; Sundat; Taiwan Tainan Giant. Bayer A.G., West Germany, FMC Corporation, In India: Bayer A.G., West Germany, FMC Corporation, USA, Brayton Chemical, USA, Agrichem Inc., USA, Mobay Chemical Corporation, USA, Lobel Chemical Corporation, USA, Mitsubishi Chemical Industry Co. Ltd., Japan, Medinpex, Hungary, Borregard Taicang Chemicals, Shaxi, Ticang, PR China, Human Research Institute of Chemical Industry, China, M/s Atul Ltd. Valsad, India.	off patent	China (Mainland) (86) India (3) Turkey (1) Pakistan (1) South Korea (1) Hong Kong (1) Taiwan (1)
Carbofuran	soybean	anticarsia	Argentina	1956			
Chlorantraniloprole	Not specified	Not specified	India	2007	Introduced by DuPont	patent	

Alternative plant protection product (ppp) (active substance or name or type)	Crop or crop type	Pest or pest type	Information source	Year intro-duction	Manufacturors	patented or off patented	suppliers
Chlorpyrifos	coffee	-	Brazil	1965	Commercially introduced by Dow Chemical Co.. In Brazil registrants: Bayer, Cheminova, Dow, Fersol, Milenia, Nufarm, and Subero. In India: Hindustan Insecticides Ltd. Dow Agro Sciences LLC, USA, Dow Agro Sciences LLC, UK, Makhteshim Chemical Works, Beer Sheva, Israel, FMC Corporation, USA, Cheminova Denmark, M/s De-nocil Crop Protection Ltd., Mumbai, India, M/s Excel Industries Ltd., Mumbai, M/s Gharda Chemicals Ltd., Mumbai, M/s Montari Industries Ltd., Delhi, M/s Siris India Ltd., Hyderabad, M/s Vantech Industries Ltd., Hyderabad, India.	off patent	China (Mainland) (398) India (21) Turkey (11) Malaysia (4) Singapore (2) Pakistan (2) Canada (1) Hong Kong (4)
Chlorpyrifos	soybean	anticarsia	Argentina	1965			
Chlorpyrifos	soybean	anticarsia	Argentina	1965			
Chlorpyrifos	soybean	anticarsia	Argentina	1965			
Chlorpyrifos	soybean	small green stink bug	Argentina	1965			
Chlorpyrifos	soybean	outhern green stink bug	Argentina	1965			
Cypermethrin	soybean	anticarsia	Argentina	1975	Insecticide reported by M. Elliott et al. (Pestic. Sci., 1975, 6, 537). Developed by Ciba-Geigy, ICI (both now Syngenta AG), Mitchell Cotts and Shell International Chemical Co. (now BASF AG). Patents GB 1413491 to NRDC Manufacturers Agro-Chemie; Agroche In India: Dow Agro Co., UK (92% min.), Mitchel Cotts Chemicals, UK (92% min.), Zeneca Ltd., UK (70% min.), Shell International Chemical Co. Ltd., UK (50%), M/s BASF India Ltd., Mumbai, M/s De-Nocil Crop Protection Ltd., Mumbai, M/s EID Parry (India) Ltd., Chennai, M/s Gharda Cehmicals Ltd., Mumbai, M/s Gujarat Insecticides Ltd., Ankleshwar, M/s RPG Life Sciences Ltd., Mumbai, M/s Rallis India Ltd., Mumbai, M/s Zeneca Agrochem (I) Ltd., Chennai.	off patent	China (Mainland) (399) India (85) United States (2) Netherlands (1) Singapore (6) Vietnam (2) Iran (Islamic Republic of) (1) Turkey (11) Jordan (7) Hong Kong (6) Malaysia (4) Brazil (4) Pakistan (2) New Zealand (2) United Arab Emirates (
Cypermethrin	soybean	small green stink bug	Argentina	1975			
Cypermethrin	soybean	outhern green stink bug	Argentina	1975			

Alternative plant protection product (ppp) (active substance or name or type)	Crop or crop type	Pest or pest type	Information source	Year intro-duction	Manufacturors	patented or off patented	suppliers
Deltamethrin	soybean	anticarsia	Argentina	1974	Introduced by Roussel Uclaf (now Aventis). In India: Hoechst Schering Agr. Evo, SA, Paris France, Roussel Uclof, Paris, France, M/s Agrevo India Ltd., Mumbai, M/s Gharda Chemical Ltd., Mumbai, M/s Tagros Chemicals Ltd.	off patent	China (Mainland) (154) India (54) Turkey (8) New Zealand (4) Spain (2) Philippines (1) Iran (Islamic Republic of) (1) Indonesia (1)
Deltamethrin	soybean	small green stink bug	Argentina	1974			
Diazinon	Not specified	Not specified	Sri Lanka	1953	Introduced in 1953 by Geigy S.A. (now Syngenta AG). Now: Aako; Cerexagri; Drexel; Hebei Golhil; Hegang Heyou; Makhteshim-Agan; Nippon Kayaku; Sannong; Sudarshan; Sundat; Syngenta. In India: Novartis Crop Protection, Switzerland, Nippon Kayaku Co. Ltd., Japan, Makhteshim Chemical Works, Israel, M/s Sudarshan Chemicals Industries Ltd., Pune, India	off patent	China (Mainland) (123) Vietnam (1) Saudi Arabia (1) Turkey (6) Jordan (5) Hong Kong (2) Brazil (2) India (2)
Dimethoate	Not specified	Not specified	Sri Lanka	1951	Introduced by American Cyanamid Co, BASF AG and other companies. Now: Cheminova; Mico; Rallis; Sannong; Shaw Wallace; Sinon; Sundat. Cheminova the leading manufacturer. Hindustan Insecticides Ltd In India: Agrimot SPA, Italy, I.p.i.c.i.SPA, Italy, M/s Chong Quing Pesticide Factory, Jing Kou, China, M/s Cheminova A/S, Denmark, M/s Rallis India Ltd., Mumbai, M/s Rallis Industrial Chemicals Ltd., Ankleshwar, M/s Shaw Wallace & Co. Ltd., Chennai, India	off patent	China (Mainland) (189) India (12) Turkey (3) Singapore (3) Canada (2) Ukraine (1) Cameroon (2) United Arab Emirates (2)
Dimethoate	soybean	small green stink bug	Argentina	1951			
d-trans Allethrin / Piperonyl butoxide / N-octyl bicycle-heptene dicar-boximide	Ornamentals	Aphids, Spruce gall aphid	Canada				
Emamectin benzoate	Not specified/ on Bengal gram	Not specified	India	Sales > 1997	Merck & Co., Inc. (now Syngenta AG). In India: Syngenta, Dhanuka	off patent	China (Mainland) (545) India (4) Hong Kong (14) Pakistan (3) Vietnam (2) Spain (1) United States (2) Singapore (1)
Ethion	soybean	small green stink bug	Argentina	1957	Introduced by FMC Corp. Manufacturers Aimco; Aventis; Bharat; Cheminova; Krishi Rasayan; Rallis; Sharda; Shaw Wallace, Hindustan Insecticides Ltd. In India: Rhone Poulenc Agrochemie, Francek Supplied by: Volkart Brothers Ltd., Switzerland. 1. M/s Rallis India, Mumbai, M/s PI Industries Ltd., Udaipur, M/s Shaw Wallace & Co., Chennai, India	off patent	India (12) Iran (Islamic Republic of) (1) Thailand (1) South Korea (1)

Alternative plant protection product (ppp) (active substance or name or type)	Crop or crop type	Pest or pest type	Information source	Year intro-duction	Manufacturors	patented or off patented	suppliers
Fenitrothion	soybean	small green stink bug	Argentina	1960	Introduced by Sumitomo Chemical Co., Ltd and, independently, by Bayer AG and later by American Cyanamid Co. (who no longer manufacture or market it). Manufacturers Rallis; Shenzhen Jiangshan; Sumitomo; Sundat. In India: Novertis Crop Protection, AG, Switzerland, Bayer Crop Science AG, West Germany, Sumitomo Chemical Co. Ltd., Japan, M/s Rallis India, Bangalore	off patent	China (Mainland) (36) Singapore (3) South Korea (2) Hong Kong (1) Taiwan (1) United Arab Emirates (1)
Fenvalerate	soybean	small green stink bug	Argentina	1974	Introduced by Sumitomo Chemical Co., Ltd and, in some countries, by Shell International Chemical Co. Manufacturers: Agrochem; Aimco; Ankur; Bharat; Dhanuka; Ficom; Gujarat; JIE; Krishi Rasayan; Parry; Rallis; RPG; Sanachem; SC Enviro Agro; Sharda; Shenzhen Jiangshan; Sumitomo; United Phosphorus. Hindustan Insecticides Ltd, In India: M/s Rallis India, Mumbai, M/s RPG Life Sciences Ltd., Mumbai, M/s Sumitomo chemical Co. Ltd., Japan.	off patent	China (Mainland) (77) India (12) Hong Kong (4) Singapore (2) Pakistan (1) South Korea (1) Malaysia (1) Spain (1)
Fipronil	Sugarcane	-	Brazil	1993	Introduced by Rhône-Poulenc Agrochimie (now Aventis CropScience, later Bayer after that BASF) in 1993. In Brazil registrant: BASF. In India: Bayer Environmental Science. SA, Lyon France. M/s Gharda Chemical Ltd., Mumbai	patented. / off patent 2011	China (Mainland) (2217) India (16) Egypt (1) Malaysia (19) Hong Kong (14) Singapore (3) United States (3) Vietnam (2)
Flubendiamide	Not specified	Not specified	India	1980	Introduced by Bayer Crop Science	Takumi (Flubendiamide) was introduced in India by Rallis in 2007-08 in collaboration with Japanese agrochemicals company Nihon Nohyaku.	
gamma Cyhalothrin	soybean	anticarsia	Argentina				India (1)
Imidacloprid	Not specified	Not specified	India	1990	Introduced in 1991 by Bayer AG and Nihon Tokushu Noyaku Seizo KK. Now: Aimco; Bayer; Jiangsu Yangnong; Sharda; Tide. In India: M/s Bayer Crop Science, AG, Germany, Wuxion Pesticide Factory, Jiangsu, China, M/s Cheminova India Ltd., Mumbai, M/s Excel Industries, Mumbai, M/s Nagarjuna Agrichem, Hyderabad, M/s Atul Ltd., Valsad, M/s Rallis India, Bangalore, M/s Gharda Chemicals Ltd., Mumbai	off patent/ off patent 2011. According to Business Line still patented	China (Mainland) (2141) India (265) Pakistan (151) United States (148) Ukraine (34) Singapore (18) Italy (2) Hong Kong (2) United States (1)
Imidacloprid + beta-Cyfluthrin SC	sugar cane	-	Brazil	1991/ 1993	Beta-cyhalothrin introduced by Bayer AG. Now: Bayer; Jiangsu Yangnong. In Brazil registrant: Bayer. In India: Bayer, Germany, Mitchell Cotts Chemicals, UK	off patent 2011	

Alternative plant protection product (ppp) (active substance or name or type)	Crop or crop type	Pest or pest type	Information source	Year intro-duction	Manufacturors	patented or off patented	suppliers
Indoxacarb	Not specified	Not specified	India	2000 (patent 1992)	Du Pont Agricultural Products. In India: M/s E.I. Du-Pont Ltd., USA, M/s Gharda Chemicals Ltd., Mumbai, M/s Atul Ltd., Valsad, India	co-marketed in India by Rallis India	India (7) Egypt (1)
lambda Cyhalothrin	soybean	anticarsia	Argentina	1984	Introduced in1985 by ICI Agrochemicals (now Syngenta AG). Manufacturers Jiangsu Yangnong; Syngenta; Tide. In India: Syngenta & Co., UK, M/s Syngenta, Mumbai, M/s Rallis India Ltd., Bangalore, M/s Nagarjuna Agrichem, Hyderabad, M/s Atul Ltd., Valsad	off patent	China (Mainland) (294) Turkey (5) Singapore (3) India (4) Hong Kong (4) United States (2) Pakistan (1) Australia (1)
Metamidofos	soybean	small green stink bug	Argentina		not in e-Pesticide manual	off patent	
Metamidofos	soybean	outhern green stink bug	Argentina		not in e-Pesticide manual, but widely used	off patent	
Novaluron	Not specified	Not specified	India	Ca 1995	Makhteshim Chemical Works, Chengdu Ablexienuo Chemical Technology Co, China Mukhtheshim chemical Works Ltd., Israel.	off patent 2011-2015	China (Mainland) (117) Israel (7) United States (4)
Phenthoate (fentoaat)	soybean	anticarsia	Argentina	ca 1976	Introduced by Montecatini S.p.A. (now Isagro S.p.A.). Manufacturers Aimco; Hanwha; Nissan; Sharda; Bharat Rasayan Ltd (BRL), Coromandel Fertilisers Limited, India. In India: Agrimont SPA, Italy, Nissan Chemical l Industries Ltd., Japan.	off patent	China (Mainland) (4) Hong Kong (1)
Profenophos	Cotton crops	Not specified	Togo	1975	Introduced by Ciba-Geigy AG (now Syngenta AG). Now: Agrochem; Hegang Heyou; Nagarjuna Agrichem; Sharda; Syngenta, Sabero organics Gujarat, Coromandel Fertilisers Limited, India. In India: Novertis Crop Protection AG, Switzerland, M/s P.I. Industries Ltd., Udaipur, M/s Nagarjuna Agrichem Ltd., Hyderabad, M/s Syngenta, Mumbai, M/s Gharda India Chemicals, Mumbai	off patent	China (Mainland) (90) India (8) Singapore (3) Egypt (1) Hong Kong (1) United Arab Emirates (1)
Spinosad	Not specified	Not specified	India	1997	Eli Lilly & Co. (now Dow AgroSciences). In India: Dow Agro Science, USA, Dow Agro Science, New Zealand.	off patent 2011 . See Dewar, 2003; according to Business Line still patented	China (Mainland) (34) United States (4) Egypt (1) Australia (1) Canada (2)
Spinosad (wrongly indicated as Spirosad)	Usually applicable to many crops. For details see Canada Rev 2007-13 Appendix VI	Eyespotted bad moth, Imported gabbageworm, Diamondback moth, Cabbage looper, Colorado potato beetle	Canada	1997			

Alternative plant protection product (ppp) (active substance or name or type)	Crop or crop type	Pest or pest type	Information source	Year intro-duction	Manufacturors	patented or off patented	suppliers
Spirodiclofen	Usually applicable to many crops. For details see Canada Rev 2007-13 Appendix VI	Rust mite, Peach silver mite	Canada	2000	Introduced by Bayer Crop Science around 2004.	off patent 2011-2015	China (Mainland) (38)
Sulphur	Cherry	Plum rust mite, Plum rust mite	Canada		In India: Novartis Agro, SA, France, M/s Stoller Enterprise Inc. Texas, USA, M/s Artee Graphite P Ltd., Delhi, M/s Excel Industries Ltd., Mumbai, M/s Sulphur Mills Ltd., Mumbai.		
Tebufenozide	Apple	Codling moth	Canada	1992	Rohm & Haas Co. (now Dow Agrosciences). In India: M/s Bayer Cropscience, USA Corp..	off patent	China (Mainland) (67614) Singapore (67) Turkey (50) Canada (50) Hong Kong (17290) India (923) Cameroon (359) Japan (355)
Thiamethoxam + cyhalothrin SC	Soybean	-	Brazil	1991/ 1980	Thiamethoxam Discovered by Ciba (now Syngenta AG) in 1991. Cyhalothrin Introduced by ICI Australia (now Crop Care Australasia Pty Ltd) and ICI Agrochemicals (now Syngenta AG). In India: M/s Sumitomo Chemical		
Thian (= thianon ?)	Cottons crops	Not specified	Togo	1942	Introduced by E. I. du Pont de Nemours and Co. (who no longer manufacture or market it), by Bayer AG (who no longer manufacture it), UCB Chemicals, and later by other companies. Now: General Quimica; India Pesticides; Sharda; UCB; Uniroyal		
Thiodicarb	Cotton crops		US-EPA RED, 1998	1985	Rhone-Poulenc, Inc., now Bayer AG.	off patent	
Thiomethoxam	Not specified	Not specified	India	Ca 1976	Bayer AG and independently by Sandoz AG (became Novartis Crop Protection AG subsequently Syngenta was formed in 2000 by the merger of Novartis Agribusiness and Zeneca Agrochemicals). In India: M/s DSM Chenve Linz St. Austria. M/s Syngenta, Mumbai, M/s Rallis India	off patent 2011-2015	China (Mainland) (3)
Trichlorfon	Usually applicable to many crops. For details see Canada Rev 2007-13 Appendix VI	Imported cabbageworm, Diamondback moth, Gabbage looper, Pepper maggot, Beet webwormx	Canada	1957	Introduced by Bayer. Now: Bayer; Cequisa; Denka; Jin Hung; Lucava; Makhteshim-Agan; Sanonda; Sinon. M/s Bayer Cropscience, A.G., Germany	off patent	China (Mainland) (51) Hong Kong (2) Taiwan (1) Canada (1)

Annex 19. Phase out schedule of the USA

Endosulfan Crop Uses and Last Use Dates at
http://www.epa.gov/pesticides/reregistration/endosulfan/endosulfan-crop-uses.html

Group A: Use ends July 31, 2012
Almond
Apricot
Broccoli
Brussels sprouts
Carrots
Cauliflower
Celery (non-AZ)
Citrus (non-bearing)
Collard greens
Dry beans
Dry peas
Eggplant
Filbert
Kale
Kohlrabi
Mustard greens
Nectarine (CA only)
Macadamia
Plum and Prune
Poplars grown for pulp and timber
Strawberry (Annual)
Sweet potato
Tart cherry
Turnip
Walnut
Ornamental trees, shrubs, and herbaceous plants
Other uses on product labels not listed above or in Group B, C, D, E, or F

Group B: Use ends July 31, 2012
Cabbage
Celery (AZ only)
Cotton
Cucumbers
Lettuce
Stone fruits not listed in Group A, including Nectarine (non-CA), Peaches, and Sweet cherry
Summer melons (cantaloupe, honeydew, watermelon)
Summer squash
Tobacco

Group C: Use ends July 31, 2013
Pear

Group D: Florida – Use ends December 31, 2014
All Florida uses of:
Apple
Blueberry
Peppers

Potatoes
Pumpkins
Sweet corn
Tomato
Winter squash
Group E: Use ends July 31, 2015
Apple
Blueberry
Peppers
Potatoes
Pumpkins
Sweet corn
Tomato
Winter squash
Group F: Use ends July 31, 2016
Livestock ear tags
Pineapple
Strawberry (perennial/biennial)
Vegetable crops for seed (alfalfa, broccoli, Brussels sprouts, cabbage, cauliflower, Chinese cabbage, collard greens, kale, kohlrabi, mustard greens, radish, rutabaga, turnip)

Annex 20. Phase out schedules for endosulfan in Belgium and Serbia

Belgium. Withdrawal of active ingredients				
Product name	**Active ingredient**	**Date of retrieval**	**Sales of stocks allowed till**	**Use allowed till**
Akodan 35 EC (8931/B)	Endosulfan	1-6-2006	1-6-2006	1-6-2007
Endofan 35 EC (8626/B)	Endosulfan	1-6-2006	1-6-2006	1-6-2007
Demecor (nr. 6749/B),	Endosulfan	15-4-2003	30-6-2003	30-6-2004
Hermoo Endosulfan EC (nr. 7285/B)	Endosulfan	15-4-2003	30-6-2003	30-6-2004
Luxan Endosulfan 500 WP (nr. 8643/B)	Endosulfan	15-4-2003	30-6-2003	30-6-2004
Luxan Endosulfan 350 EC (nr. 8643/B)	Endosulfan	30-6-2003	31-12-2003	31-12-2004
Akodan 35 EC (nr. 8931/B)	Endosulfan	30-6-2003	31-5-2004	31-5-2005
Endofan 35 EC (nr. 8626/B)	Endosulfan	30-6-2003	31-5-2004	31-5-2005
Endosulfan Protex (nr. 7582/B)	Endosulfan	30-6-2003	31-5-2004	31-5-2005

source: www.fytoweb.fgov.be/NL/DOC/opgebruik.xls
http://www.fytoweb.fgov.be/NL/Pers/20030120%20Beperking%20gebruik%20endosulfan.htm
download: 16/03/2011

Serbia (2007). Withdrawal of active ingredients				
Product name	**Active ingredient**	**Date of decision**	**Sales of stocks allowed till**	**Use allowed till**
Beveticid	Endosulfan	13-12-2006	30-6-2008	31-12-2009
Endofan 35 EC	Endosulfan	13-12-2006	30-6-2008	31-12-2009
Thiodan E-35	Endosulfan	13-12-2006	30-6-2008	31-12-2009

source: http://www.fvm.gov.hu/doc/upload/200710/3_serbia_ceureg_ppp.pdf
download: 16/03/2011

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