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An Interpretative Summary of the Study on: Pesticide use in cotton in Australia, Brazil, India, Turkey and the USA

By

The Expert Panel on Social, Environmental and Economic Performance of Cotton Production (SEEP)

1. Introduction to the Study

1.1 Overall study objective and the SEEP mandate

SEEP is the International Cotton Advisory Committee (ICAC) Expert Panel on the *S*ocial *E*nvironmental and *E*conomic *P*erformance of Cotton Production. The Expert Panel was formed as a result of deliberations during the 65th Plenary Meeting of ICAC in Goiania, Brazil, in September 2006 to provide objective, science-based information on the negative and positive social, environmental and economic aspects of global cotton production. It comprises thirteen members who represent a broad cross section of countries, relevant knowledge, expertise and interest, not only from the traditional cotton industry, but also from universities and government agencies. SEEP terms of reference include the formulation of recommendations for further action as appropriate to improve sustainability in the performance of the cotton industry.

Pesticide use in cotton is a critical and common concern whenever the theme of sustainability of cotton cultivation is discussed. In the 1990s, the use of crop protection chemicals on cotton peaked, accounting for some 20% of all global insecticides[1] applied annually for agricultural purposes. However, according to Cropnosis, a private company in the UK, cotton's share by value of global pesticide consumption declined from 11% in 1988 to 6.8% (US$3 billion) in 2008. Similarly, the share of insecticide use declined from 19% in 2000 to 15.7% in 2008.

Over the last two decades, governments, research institutes and cotton industry organizations of many cotton-producing countries have enacted policies and interventions to promote a broader approach to pest management and mitigate reliance on chemicals. Some governments have promoted the adoption of integrated pest management (IPM)[2] through the implementation of large-scale programmes. Since 1996, biotech cotton crops have been gradually introduced in ten cotton-producing countries[3] to control lepidopteran pests. Finally, further strengthening of regulatory control of pesticide use for health or environmental reasons in several countries has had an effect on the spectrum of pesticides available for use in cotton. The results attained in terms of reduction in pesticide use and associated risks emanating from these interventions vary from country to country and depend on a number of factors. An important gap that SEEP identified is the lack of current country-specific pesticide use data to accurately measure the impact of changes occurring in plant protection practices.

It is in this context that the study on "**Pesticide use in cotton in Australia, Brazil, India, Turkey and the USA"** (hereinafter referred to as "Study") was conceptualised with the following two specific objectives:

1. Analyze trends in the use of pesticides on cotton over 14 years in Australia (1995-2007), Brazil, India, Turkey and in the USA (1994-2006)
2. Evaluate the hazards of pesticide use on cotton to human health and the environment in the same countries.

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[1] Insecticides are a subset of pesticides.
[2] "Integrated pest management (IPM) means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimise risks to human health and the environment. IPM emphasises the growth of a healthy crop with the least possible disruption to agroecosystems and encourages natural pest control mechanisms.", FAO, 2002.
[3] Argentina, Australia, Brasil, Burkina Faso, Colombia, China, India, Mexico, South Africa, and the USA.

SEEP members, based on their knowledge of the cotton sector, have prepared this Interpretative Summary to complement the findings of the Study with information on the cotton pest scenario, pest management approaches and factors that might have influenced the use of pesticides in the studied countries over the last decades.

1.2 Scope of the study

The Study focuses on trends in the use of pesticides applied in cotton along with an assessment of the hazards of those pesticides. A hazard is defined as the inherent property of a pesticide that has the potential to cause adverse effects to an organism on the basis of its physical and chemical characteristics. It is important to note that the assessment of hazard does not provide an indication of the actual risk in the field. Risk is defined as the probability that an adverse effect occurs and it is a function of the hazard and the exposure to the specific substance. Risks largely depend on local factors that affect exposure (e.g. environmental factors, circumstances under which the chemicals are applied, use of personal protective equipment, measures to reduce exposure, etc.).

The Study does not look into pesticide use efficiency. It provides figures in terms of grams of active ingredient used to produce a kilogram of lint cotton in the five countries (Figure 5 in the Study). However, these figures do not take into account the toxicity of the pesticides used nor do they distinguish between low and high dosage formulations.

1.3 Data sources

SEEP obtained two datasets on pesticide use from commercial providers.

The first dataset was obtained from GfK Kynetec, a market research and consulting business that specializes in agriculture and affiliated fields. GfK Kynetec is part of the fourth-largest marketing research provider in the world. It is headquartered in Nuremberg, Germany. The data were compiled using a SIGMA™ methodology described by the firm as ‘a combination of panels for the U.S. and UK markets linked with original in-country industrial market research. In each country, the researcher typically undertakes around 30 (but it can be as many as 60) in-depth highly intensive interviews with knowledgeable third parties. Each interview provides an insight into a subset of the total market, and allows for cross-reference of data from multiple sources to ensure consistency of product data collected’. It included annual use data of active ingredients in cotton for the five study countries. For each active ingredient, this dataset contained information on chemical group, area treated, amount used, and the application rate (kg a.i./ha). For Brazil, India, Turkey and the USA this information was available for three years: 1994, 2000 and 2006. For Australia, information was available for five years: 1995, 1999, 2000, 2001 and 2002.

The second dataset was provided by Crop Consultants Australia Inc. (CCA) The CCA is primarily an association that provides agronomic advice to crop producers in Australia. The Western Research Institute collected and supplied industry data directly to the CCA. The database contained information for Australia on pesticide use in conventional cotton and the biotech cotton Bollgard® for the period 2003-2007. The information in this dataset included active ingredients applied, the application rate used (kg a.i./ha) during each season in the period and the total area of application on both conventional and biotech cotton.

It should be noted that the Study does not include herbicides and, throughout the report, the word “pesticides” refers only to the following groups: acaricides, fungicides, inorganic pesticides, insecticides, molluscicides and nematicides.

Completeness and accuracy of the data contained in the two databases was an initial concern because there are few sources of other data to compare them with. However, the average-usage data contained in the database for Australia are of a similar order to the data presented in Agrow report (World Crop Protection Markets) for year 2004. Average use figures in India for 2004 are comparable to the data collected by the FAO-EU IPM project for cotton in the main cotton producing states of the country. Data on pesticide usage in USA agriculture have been collected by the United States Department of Agriculture (USDA) since 1990. For the time periods covered by the Study, data are available for cotton for the years 1994, 2000, 2005, and 2007. The USDA data for the functional groups used in the Study in kg active ingredient per hectare were similar for 1994 and, although no specific USDA data were available for 2006, values reported for 2005 and 2007 were in line with those used in the Study for 2006. However, the values reported by USDA for 2000 were almost twice as high as those found in the dataset used for the Study. The primary difference was that the nematacide dichloropropene was not reported in the GfK Kynetec dataset for that year (USDA 1990-2008).

The SEEP Panel recognizes that there are limitations to the datasets. First, information for three separate years does not allow in-depth evaluation of consistent trends in pesticide use because yearly fluctuations may go unnoticed or incidental data in one of the three years may disturb the overall picture. Second, data refer to pesticide sales which do not account for counterfeit pesticides and products sold through the informal markets in some countries. It is therefore possible that the results are an underestimation of the actual use of pesticides in countries where pesticide regulations are not effectively enforced.

Thus, even though the Panel developed confidence in the datasets purchased for this study based on the sound methodology used by the data provider in their data collection and the aforementioned crosschecks with other sources of information, interpretation of the results was done with care, and observations on any trends in this report must be seen against the background of the limitations of the datasets.

1.4 Data analysis

The research group on Environmental Risk Assessment of Alterra, Wageningen University, The Netherlands, was contracted by SEEP to carry out the Study. SEEP developed the study proposal and provided scientific consultation and overall supervision of the report.

The Environmental Risk Assessment group has expertise in research and consultancies on the fate, effects and aquatic risk assessment of pesticides. The multi-disciplinary group includes chemists, ecotoxicologists, toxicologists, soil scientists, hydrologists and aquatic ecologists who cooperate closely. The group helps shape present regulations and provides regulators and policy makers of the European Union with valuable scientific underpinned instruments and tools. The group has developed models that are currently used to assist decision-making in pesticide regulations.

1.5 Definition of environmental toxic load (ETL), weaknesses and strengths of the metric

A new indicator developed by the Alterra research group, called environmental toxic load (ETL), was applied to assess environmental hazards. The indicator represents the average amount of toxic pressure posed by the pesticides applied on one (1) hectare of cotton in one (1) year. The ETL can only be used to evaluate the impact of changes in pesticide use on environmental hazards between years and countries. The indicator is based on quantitative information on pesticide use and the environmental toxicity of the considered pesticides. As explained by the group: "ETL is not an indicator of the risk associated with the use of a pesticide, or the actual impact on organisms in the field, but rather a composite indicator for the relative hazard based on actual pesticide use." Preferably, these hazard assessments should be used to decide whether more comprehensive follow-up risk assessments are required.

2. Main findings

2.1 Use of pesticides on cotton in the five studied countries in 2006/07

Analysis of the most recent information available for each country resulted in the following figures for pesticide use on cotton:

1 kg a.i./ha in Australia (2007)
4.9 kg a.i./ha in Brazil (2006)
0.9 kg a.i./ha in India (2006)
0.6 kg a.i./ha in Turkey (2006)
1.2 kg a.i./ha in the USA (2006)

In Australia, the average amount of pesticides (kg a.i.) applied per hectare steadily declined after a peak reached in 1999. No clear trends in amounts used were distinguishable in India, Turkey and the USA, but this may be due to the limitations of the dataset mentioned in section 1.3. In Brazil, the use of pesticides increased during the years studied and by 2006 was 4-8 times higher than in the other countries.

In all countries, insecticides, and among these organophosphates, were the major group of pesticides used (as noted earlier, herbicides were not analyzed).

2.2 Main trends with regards to hazards to human health and the environment

In most of the countries, the use of extremely and highly hazardous chemicals (WHO Hazard Class I; http://www.who.int/ipcs/publications/pesticides_hazard_rev_3.pdf) was lower in 2006 than in previous years. However, in 2006 WHO Hazard Class I active ingredients were still being used on cotton at the rate of 0.89, 0.35 and 0.21 kg a.i./ ha, respectively, in Brazil, the USA and India. In Australia and Turkey, the use was significantly lower (0.07 kg a.i./ha).

A small number of substances (listed in Table 10 of the Study and reported below) contributed to more than 50% of the human health hazards caused by overall pesticide use on cotton and more than 50% of the overall ETL. Four substances alone, namely endosulfan, diafenthiuron lambda-cyhalothrin and chlorpyrifos, are responsible for around 60% of the hazard posed to fish.

Active ingredients causing 50% of the hazard to human health according to WHO classification, and to the environment according to the ETL, in the five studied countries

HUMAN HEALTH (Acute toxicity, carcinogenicity, genotoxicity, and reproductive toxicity)	Aldicarb, abamectin, carbaryl, lindane, parathion-methyl, propargite, monocrotophos, methamidophos, zeta-cypermethrin
ENVIRONMENT	
Fish	Chlorpyrifos, diafenthiuron, endosulfan, lambda-cyhalothrin, zeta-cypermethrin
Daphnia	Cypermethrin, chlorpyrifos, lambda-cyhalothrin, zeta-cypermethrin
Bees	Aldicarb, cyfluthrin, dimetoate, imidacloprid, monocrotophos, spinosad, thiodicarb, Zeta-cypermethrin

2.3 Crop productivity and pesticide use

The Study showed that there is no correspondence between variation in pesticide use over time and cotton yields. Australia achieved a decrease in per-hectare average pesticide use over the studied period, while the average cotton yield per hectare increased. Turkey achieved the second highest cotton yield per hectare among the five countries, despite the lowest average amount of pesticides used per hectare of cotton and not having introduced biotech cotton. In Brazil, average yields grew in parallel with an intensification of the use of pesticides.

2.4 Comparison with other crops

National-level data on the use of pesticides for other crops are not easily available. Some comparative figures are presented in the Agrow Report “World Crop Protection Markets” for the reference year 2003. According to this report, the total agro-chemical sales in Brazil amounted to 3,136 million US$, and the top four crops for pesticide consumption by value were soybean (45%), cotton (10%), sugar cane (8%) and maize (8%) (source of data: Sindacato Nacional da Indústria de Produtos para a defesa Agricola SINDAG). Insecticides made up some 23% of pesticide sales in 2003, with cotton as the crop with the highest consumption. As insecticide use on cotton increased in Brazil over the three years investigated by the Study (1994, 2000 and 2006), it seems likely that cotton remains among the crops with the highest insecticide use in that country.

According to the same Agrow report, the agro-chemical market in the USA in 2003 was US$7,123 million and cotton was the third largest crop for total pesticide use by value (8%) after maize (23%) and soybean (19%). In 2008, according to Croplife Foundation, insecticide sales for cotton represented 10% of total sales, confirming that cotton accounted for the second largest amount of insecticide use, after maize (13%) (available at http://www.croplifefoundation.org/cpri_benefits_insecticides.htm>).

Worldwide sales of pesticides used in cotton 2004-2007 consistently represented ca. 8% of total sales, with pesticide sales for cereals, fruit and vegetables, maize, rice and soybean being the same or higher (Table 1).

Tabel 1. Proportion of pesticide sales for various crops worldwide 2004-2007 (Source: Cropnosis Limited)

Crop	2004 Sales (%)	2006 Sales (%)	2007 Sales (%)
Cereals	16	16	17
Cotton	8	8	8
Fruit & Vegetables	29	30	30
Maize	9	9	9
Canola / Oilseed Rape	1	2	2
Rice	9	9	8
Soybean	10	10	10
Sugar Beet	2	2	2
Other Crops	14	15	15

3. BIOTECH COTTON: SUMMARY OF FINDINGS

Biotech cotton crops were introduced in the USA in 1996, in Australia in 1997, in India in 2002, and in Brazil in 2007. In Australia, the comparison of disaggregated pesticide data for the years 2003-2007 showed a higher average amount of active ingredients used per hectare of conventional cotton than biotech cotton. In India and the USA, a less pronounced decrease in pesticide use was recorded in the years following the introduction of biotech cotton crops. However, it must be noted that the average pesticide use per hectare of cotton in Australia was much higher (greater than 4 times) than in India or the USA at the time of the introduction of biotech cotton.

It is plausible that the introduction of biotech cotton crops contributed to these changes. However, a clear attribution is not possible as other causal factors were not taken into account in the Study (*e.g.*, Best Management Practices (BMP) programmes, changes in registration policies, weather conditions, pest occurrence), nor was there information available on insecticide use on biotech cotton in comparison to conventional cotton for countries other than Australia.

4. FACTORS INFLUENCING THE USE OF PESTICIDES IN COTTON IN THE FIVE COUNTRIES

In this section, the main factors that have influenced changes in pesticide use, including pesticide regulations and policies and field-level management programmes, are described for the five countries.

4.1 Australia

While total use of pesticides in Australia varies from season to season, due to fluctuation in both the areas of cotton planted and pest pressure, the Study highlights that the average amount of pesticides (kg a.i.) applied per hectare on cotton in Australia has been declining since a peak was reached in 1999. [See the separate report, “Factors Influencing the Use of Pesticides in Cotton in Australia” …….] At the same time, the average yield per hectare has been increasing. A number of factors are likely to have contributed to this combination of reduced pesticide use but increased yield per hectare. In particular:

The Australian cotton industry has a strong focus on plant breeding and on Integrated Pest Management (IPM), which is manifested through: an extensive research effort, supported by the industry; detailed varietal information being made available; the codification of the research in the form of IPM Guidelines; a coordinated national implementation effort; the provision of formal training and education in IPM; a comprehensive Cotton Pest Management Guide (published annually); a resistance monitoring programme; and an Insecticide Resistance Management Strategy that is reviewed and updated every year to reflect the latest research findings, any new products, and the results of the resistance monitoring programme.

The great majority of the cotton now planted in Australia are biotech varieties, and research undertaken by the industry demonstrates that there is a significant difference in the total number of sprays applied to conventional compared to biotech cotton. This difference is attributable to the reduction in the number of insecticide applications targeted against *Helicoverpa spp*., in biotech crops.

4.2 Brazil

Of the five countries involved in the study, Brazil is the only one with true tropical production systems; today more than 90% of the areas where cotton is grown are areas of true tropical agriculture [See the separate report, “Factors Influencing the Use of Pesticides in Cotton in Brazil” …….].

Cotton production during the 1970s and 1980s was concentrated in northeast Brazil, principally the states of Piauí, Ceará, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas and Bahia, and in the southeastern states of Parana and Sao Paulo. This started to phase out in the 1980’s and early 1990s. The northeastern region in Brazil was literally taken over by boll weevil and the small farming units were unable to control this pest. This was due to a number of factors with the main one being that a large part of the cotton was cultivated as a perennial. The southeastern states of Brazil lost their importance as a result of competition from sugarcane as well as a series of external economic factors. In the eighties and nineties the textile industry imported an enormous amount of cheap subsidized cotton that drove growers from the activity. Brazil became a major importer of cotton in the mid nineties reaching a level of over 400.000 tons per year. In the new era of cotton production output tripled in less than 15 years as a result of more technology and capital investment in the sector. The importance of cotton production has been acknowledged by recent governments, and as a result the production levels have remained stable since the beginning of this century.

The modern production of cotton in Brazil today requires a very high level of knowledge and capital elements, trained labour, financial resources and organization. This level of input is required because there are few natural elements to help control pests such as cold, frost, and extreme drought. This dry land /upland cotton production helps to make this unique situation a major challenge to the success of future production and the long term stability of the Brazilian cotton industry. There are numerous efforts being made to establish new and better BMP and IPM practices, but in the last ten years the economic climate has not allowed growers to dedicate financial resources to this effort. In the last few years, boll weevil has become a major threat to the success of Brazilian cotton production requiring in some cases an excess of 12 insecticide applications per year for control. The cotton producers realize that the increase in pesticide use is the result of this pest and as a consequence are taking measures to effectively establish a control / eradication program. This will be achieved through ABRAPA – Brazilian Cotton Producers Association, the State Producer Associations, together with state governments and the Ministry of Agriculture, and, hopefully, a part of the funds from the WTO dispute settlement.

4.3 India

National consumption of pesticides in India has been decreasing since the peak was reached in the early 1990s. [See the separate report, “Factors Influencing the Use of Pesticides in Cotton in India” …….] Out of the total pesticide use in the country in 2000, insecticides accounted for 80%, followed by herbicides (15%) and fungicides (1.46%). The excessive use of pesticides of the previous decade had a negative impact on productivity. National cotton yields stagnated at around 190 kg/ha till 2003-2004 to thereafter steadily increase. In 2008, the national average was 467 kg/ha.

The Government of India (GoI) has adopted IPM as the overriding principle of plant protection to reduce dependency on chemical control. There are thirty-one Central Integrated Pest Management Centers (CIPMCs) operating under the Directorate of Plant Protection, Quarantine and Storage to promote the concept of IPM across the country. The Food and Agriculture Organization of the United Nations (FAO) has been committed to support GoI through the implementation of a series of regional IPM programmes to build human and institutional capacity using the Farmer Field School approach. In 2002, the Central Institute of Cotton Research in Nagpur launched the insecticide resistance management programme (IRM) in ten cotton-growing states of India implemented by state agricultural universities. In the same year, biotech cotton varieties were introduced for commercial use; In 2008-09, 7.6 million hectares, nearly 81% of the total cotton area, was under biotech hybrids. A significant governmental investment in the cotton sector has also been made through the Technology Mission on Cotton (TMC) launched in 2000 to increase cotton production, productivity and improve the quality of cotton, and thus increase the income of cotton growers.

From the regulatory perspective, in April 1997, GoI banned the use of hexachlorocyclohexane (BHC), which accounted for about 30% of total pesticide consumption. In the same decade, subsidies for insecticides were abolished.

The factors that have influenced pesticide use in India are several and interlinked, including a ban on BHC, removal of pesticide subsidies, introduction of low-volume formulations, IPM programmes and the release of biotech cotton, but others remain to be identified. A clear attribution of change to a single factor is not possible; however, the combined effect has resulted in a significant decrease in pesticide use

4.4 Turkey

Annual pesticide consumption in Turkey is about 30,000 metric tons. Average consumption is 0.5 kg a.i. per hectare. This is low compared to averages in developed counties. However, consumption of pesticide is very heterogenous in Turkey. Forty percent of pesticides are used in the areas of Adana, Mersin and Antalya. Adding Izmir and its peripheral regions to this figure, the total comes to 65%. About 29% of all pesticides used in Turkey are used on cotton. These regions account for about 40% of total cotton area in Turkey. Therefore, about 40% of Turkish cotton is subject to relatively heavy pesticide applications. On the other hand, southeast Turkey, which accounts for 60% of cotton production in Turkey, accounts for just 7% of pesticide use on cotton.

4.5 USA

There has been a downward trend in the amounts of pesticide applied to cotton in the U.S. in the last 15 years. [See the separate report, “Factors Influencing the Use of Pesticides in Cotton in the U.S.” …….] A number of factors have contributed to this decline, including IPM, the Boll Weevil Eradication Program (BWEP), and biotech cotton. However, it must be noted that that there have been fluctuations in the amounts and kinds of insecticides used in certain years. For example, at times the BWEP has had a negative impact on the yearly use of pesticides. Different cotton growing regions have joined the BWEP in different years. Typically, heavy applications of insecticides are required in the first year of the program followed by years when applications are made based on monitoring data. A large increase in the number of regions joining the program began in 1993, and in 1999-2000 high insecticide use coincided with more than 800,000 hectares in Texas coming into the program.

In addition, the reduction in amounts of insecticide used has led to a change in the status of several pests that attack cotton. This has been especially apparent in the mid-south and southeastern states where there has been both a high adoption of biotech cotton varieties and where the BWEP has reached completion. In the past, insecticides applied for control of tobacco budworm, cotton bollworm and the boll weevil had inadvertently kept populations of the tarnished plant bug (*Lygus lineoaris*) and the stink bug complex (green stink bug, *Acrosternum hilare;* southern green stink bug, *Nezara viridula*; and brown stink bug, *Euschistus servus*) at relatively low levels. But in a low insecticide environment, these pests have become major late season economic pests, and the number of applications of insecticide for their control has increased requiring different kinds of insecticides. However, the overall average number of applications made and amounts of insecticide used have continued to decline in spite of the change in the pest complex.

Farmers have a relatively wide spectrum of pesticides available for their use to manage the cotton crop, some of which are in the WHO Class I category (see section 2.2 of this Summary). In the U.S., cotton is considered a food crop, and pesticides used on cotton are regulated accordingly by federal and state governments. In addition, the U.S. cotton production system is highly mechanized; a combination of closed mixing systems, personal protective equipment and enclosed cabs for application equipment, all significantly limit worker exposure. Also in place are stringent laws backed up by strict enforcement to ensure the safety of the cotton product, safety of the workers, and safety of the environment.

5. Recommendations

i) SEEP recommends that WHO Hazard Class I pesticides be eliminated in countries where adequate provisions for their management are not in place (see section 6 of the Study/Alterra Report for details on “adequate provision”). In many developing countries, regulatory control over the use of pesticides to reduce health and environmental risks to acceptable levels is still incomplete or not sufficiently enforced due to the lack of technical expertise and resources. In these countries, the use of pesticides that fall in WHO Hazard Class I poses a direct and a real risk to people handling such substances. Countries are encouraged to use the International Code of Conduct on the Distribution and Use of Pesticides (refer to section 6) to enhance their capacity to reduce risks related to pesticide use.

ii) SEEP recommends that cotton-producing countries where the use of pesticide is higher than 1 kg of a.i. per ha should analyse the causes of such use and address these causes. Four of the five countries studied have been able to reduce their average pesticide use per hectare to around or below 1 kg of a.i, regardless of the type of farming systems prevalent and the pest load occurring (Figure 3 in the Study).

iii) SEEP recommends that the use of active ingredients that account for the highest contribution to the environmental toxicity load (listed under section 2.2 of this Summary) should be minimized to reduce the environmental hazards to aquatic organisms and bees.

iv) SEEP recommends that pesticides known to pose possible risk of harm to the unborn child or to breast-fed children should be eliminated from the cotton production system. Active ingredients falling into this category were used at an almost negligible rate in the five countries studied, and elimination of these products from cotton cultivation would seem attainable.

v) SEEP recommends that governments, with the involvement of all concerned stakeholders in the cotton sector, make a strong effort to promote best management practices in plant protection and to reduce reliance on pesticides and subsequent risks to the environment and human health. Integrated pest management (IPM) should be the major instrument to achieve and sustain long-term reductions in pesticide use in the cotton industry. The experience of countries that have already enacted effective IPM programmes should be considered by countries that are still devising strategies to reduce pesticide use.

vi) SEEP recommends that governments consider both environmental and health risks while formulating clear policy statements relative to pesticide risk reduction. This requires close collaboration with the responsible authorities.

vii) SEEP recommends that governments promote the collection of reliable crop-specific data related to pesticide use. Accurate data are indispensable for the follow-up of risk assessment studies, although schemes of data collection might vary according to country conditions.

viii) SEEP recommends that follow-up risk assessment studies be conducted. The Study (Alterra Report) provided important insights into the social and environmental sustainability of cotton cultivation. It is important to note that the evaluation of hazards alone does not allow drawing definitive conclusions on the actual risks posed to the environment and human health by the use of pesticides in a specific context.

6. INTERNATIONAL AGREEMENTS TO REDUCE RISKS ASSOCIATED WITH PESTICIDE USE

International organizations have developed international agreements and policies to enhance the capacity of member countries to reduce risks related to pesticide use. Three important policy instruments are:

(1) International Code of Conduct on the Distribution and Use of Pesticides (http://www.fao.org/DOCREP/005/Y4544E/y4544e00.htm). The voluntary Code of Conduct, adopted by all FAO member countries, provides a framework that specifies responsibilities of governments, the pesticide industry and other stakeholders in reducing risks, particularly for countries lacking adequate and effective regulatory infrastructures and control systems for the sound management of pesticides. In order to reduce risks associated with the use of pesticides, governments are encouraged to review the pesticides marketed in their countries, carry out occupational health surveillance programmes, provide guidance and instruction to medical services on the treatment of pesticide poisoning, and provide advisory and extension services to producers. Under Articles 3.5 [4] and 7.5 [5], it is recommended that products that fall in WHO Hazard Class I should be avoided in countries where adequate provisions for their sound management are not in place. Provisions include socio-economic feasibility of the use of adequate personal protective equipment, availability of effective extension and advisory services to workers and producers, and accessibility of appropriate medical assistance for pesticide poisoning.

[4] 3.5 Pesticides whose handling and application require the use of personal protective equipment that is uncomfortable, expensive or not readily available should be avoided, especially in the case of small-scale users in tropical climates. Preference should be given to pesticides that require inexpensive personal protective and application equipment and to procedures appropriate to the conditions under which the pesticides are to be handled and used.

[5] 7.5 Prohibition of the importation, sale and purchase of highly toxic and hazardous products, such as those included in WHO classes Ia and Ib, may be desirable if other control measures or good marketing practices are insufficient to ensure that the product can be handled with acceptable risk to the user.

(2) Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (http://www.pic.int/ home.php?type=s&id=77). The Rotterdam Convention, ratified by 134 parties as of August 2010, including Australia, India and Brazil, aims to promote shared responsibility and cooperative efforts in the international trade of certain hazardous chemicals. The USA signed the Convention on September 11, 1998, but Congress has not ratified it. Turkey has not ratified the Rotterdam Convention. Chemicals that have been banned or severely restricted for health or environmental reasons by Parties and which have been notified by Parties for inclusion in the Prior Informed Consent (PIC) procedure are listed under the Annex III of the Rotterdam Convention. Inclusion of a pesticide under Annex III indicates that Parties recognise the serious environmental and health concerns raised by their use.

(3) Stockholm Convention on Persistent Organic Pollutants**.** The Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically and accumulate in the fatty tissue of humans and wildlife. Exposure to Persistent Organic Pollutants (POPs) can lead to serious health effects including certain cancers, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to disease, and even diminished intelligence. Given their long range transport, no one government acting alone can protect its citizens or its environment from POPs. In response, the Stockholm Convention, which was adopted in 2001 and entered into force in 2004, requires Parties to take measures to eliminate or reduce the release of POPs into the environment. The Convention is administered by the United Nations Environment Programme and based in Geneva, Switzerland.

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