

# Ethical-Sugar

*For a sugar which respects human beings and its environment*

## Status report on sugar cane agrochemicals management

Agrochemicals in the sugarcane industries:  
health and environmental challenges and solutions

19 December 2009



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Special thanks for  
Remi Mussillier, Sup de Pub Lyon (France), Robert Quirck, Gentleman Farmer (Australia)

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# About Ethical Sugar

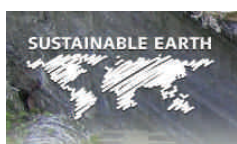
This research was undertaken for Ethical Sugar, an NGO that seeks to enhance dialogue within the sugar-ethanol industry with a view to improving its social and environmental development. Trade unions, companies, civil society activists and academics are all brought together as part of this dialogue, which allows Ethical Sugar to construct a more rounded vision of the different situations and positions that pertain in the industry and facilitate a multipartite form of Corporate Social Responsibility.

The recent growth in ethanol consumption is seen as an opportunity to foster this CSR as corporations in different countries are brought closer together through the influx of foreign direct investment, on the one hand, and the creation of new supply chains to export fuel, on the other. Ethical Sugar believe that as consumers come to recognise the close links forged across national boundaries, it is incumbent upon producing companies to surpass minimal legal standards of production and lay down a long-term strategy to avoid negative publicity and reassure their partners about their business ethics. In mature markets such as the EU or North America, this strategy has a longer history and typically invokes a strong element of social monitoring.



In 2009, Ethical sugar obtained a score 8 out of the maximum of 10 on NGO Transparency barometer from the Prometheus Foundation. The Prometheus Foundation was launched on December 27, 2005 by French parliamentarians.

The Prometheus Foundation is composed by International companies such as AREVA, SANOFI AVENTIS GDF-SUEZ...



In 2008, Ethical sugar joined the international Sustainable Earth Alliance network.

Sustainable Earth is an informal alliance, made up of individuals and organizations with a willingness to work sufficiently strong to match the challenges they face. These men and women together build synergies, a relationship of trust and concrete initiatives.



Since 2006, Ethical Sugar is member of the Steering committee of the Better Sugarcane Initiative (BSI). The BSI is a global multi-stakeholder non-profit initiative dedicated to reducing the environmental and social impacts of sugar cane production.

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# Abstract

The progress in agricultural yields resulting from the introduction of agricultural chemicals has not come without cost for human health and the environment. While the pesticide requirements of sugarcane crop are relatively modest compared to other similar cash crops, agrochemicals continue to generate harmful impacts especially in the major sugarcane producing developing countries. Institutional weaknesses as well as the lack of financial and human resources often prevent effective chemicals regulation and the implementation of good pesticide application practices. This document reviews some of the key problems and challenges associated with agrochemical use in sugarcane production, and examines possible solutions. The report focuses on the negative impacts of inappropriate agrochemical use, and therefore addresses neither the many positive impacts of pesticide use, nor the other potential social and environmental problems associated with sugarcane cultivation.

Apart from the intergovernmental treaties in the area of chemicals regulation in general (e.g. the Rotterdam and Stockholm conventions) many international initiatives specific to sugarcane seek to foster better use of agrochemicals and alternative management practices such as Integrated Pest Management and organic farming. Such initiatives include multistakeholder efforts to promote better production practices (e.g. Better Sugarcane Initiative, Roundtable of Sustainable Biofuels), international codes of practice, and sustainability certification schemes. The governments and chemicals industry in the developed world should redouble their efforts to provide technical assistance and capacity building to developing countries in the areas of chemicals regulation, including implementation and enforcement. As part of their corporate social responsibility, the chemicals companies should collaborate with governments, pesticide users and farmers in fostering the adoption of alternative pest management practices, providing training and information to chemical users, and implementing adequate risk assessment and chemicals regulation procedures.

## Executive summary

While the introduction of agricultural chemicals has allowed spectacular increases in crop yields in practically all areas of agriculture, this progress has not come without cost for human health and the environment. Inadequate use of agrochemicals is particularly problematic in developing countries, which often lack the sufficient institutional conditions to ensure that these chemicals are used safely, without endangering workers health, or contaminating the environment.

Sugarcane farming does not require a lot of pesticides; in fact, the use of insecticides and fungicides is below the average for comparable cash crops. The vast majority of agrochemicals used for sugarcane are herbicides. Despite the moderate levels of use, agrochemicals are a concern also in this sector, not least because eight out of ten major sugarcane producers are developing countries.

The widespread introduction of agrochemicals – after the Second World War in the industrialised countries, and since the ‘Green Revolution’ of the 1960s in the developing world – allowed significant increases in crop yields. However, over the past couple of decades, the health and environmental problems related to the high-input agriculture have become increasingly recognised. Government policies often lag behind such recognition, and often continue to directly or indirectly subsidise the use of chemical inputs, thereby contributing to overuse of agrochemicals.

And yet, promising examples exist of multistakeholder, government and private initiatives promoting better use of agrochemicals, including in the sugarcane sector more specifically. This document reviews some of the key problems and challenges associated with agrochemical use in sugarcane production, and examines some of the possible solutions to the problems. The report focuses on problems stemming from inappropriate agrochemical use, and therefore addresses neither the many positive impacts of pesticide use, nor the other potential social and environmental problems associated with sugarcane cultivation.

### **Health and environmental impacts from agrochemical use in sugarcane cultivation**

Exposure of field workers to agrochemicals is the main source of health problems associated with pesticide use in sugarcane production. Workers may become exposed during the application of the chemicals in the field, the preparation of the chemical mixtures, or the treatment and storage of seeds and cuttings. Symptoms from acute intoxication include skin and respiratory problems, bleeding, convulsions, nausea, vomiting, and in the worst cases death. Long-term exposure, in turn, may increase cancer risk, weaken the immune system, or generate neurological symptoms, endocrine disruptions, genetic mutations, and behavioural changes.

The type and the extent of health impacts depend not only on the characteristics of the chemicals, but also on factors such as the general health, nutritional status and lifestyle of the individuals exposed to chemicals, on the prevailing environmental and climatic conditions, as well as on the broader socio-economic context. Health problems caused by pesticide use in the developing countries often go underreported, for instance because public authorities lack abilities to monitor, identify and address the problems.

The surface and groundwater pollution as well as soil contamination caused by inappropriate pesticide use also have serious consequences on public health, by exposing the local populations to environmental pollution. Sometimes the objectives of reducing the environmental and health impacts of agrochemicals enter in conflict, such as when environmentally harmful chemicals are replaced by those that are less persistent but more acutely toxic to humans.

### **Risk assessment and chemicals regulation**

Assessing the health and environmental impacts of agrochemicals is a highly complex task, often involving disagreements not only between different stakeholders, but also among scientific experts, on issues such as risk perceptions, the interpretation of the precautionary principle, and the allocation of the burden of proof. Chemicals registration procedures and criteria therefore vary from one country to another – the differences between the US and the EU being a case in point. Regulatory decisions are made not only on the basis of purportedly ‘objective’ and ‘pure’ science, but risk assessments unavoidably also reflect the varying economic, social, cultural and political considerations. Notwithstanding these complexities, this report tentatively identifies the potentially most problematic chemicals in sugarcane cultivation on the basis of two criteria: the chemicals have not been registered for use in the EU, and they are on the Pesticide Action Network list of “bad actor” chemicals.

### **International agrochemicals markets and agrochemical problems in the developing countries**

Agrochemicals use and the associated problems are intimately linked with the operation of the global pesticide market, which is today dominated by some 20 large multinational companies. Major changes have occurred in these markets over the past couple of decades: the developing countries are no longer mere importers, but have become major producers of agrochemicals; international action to phase out the most harmful chemicals is bearing fruit, and the stricter regulation has allowed the global agrochemicals companies to develop and sell higher-value added products.

Pesticide use in the developing countries is intimately linked with the operation of the international agrochemicals markets. Agricultural production in these countries is often polarised between two sections: one producing cash-crops for the export market and another supplying food for the domestic market. Only the former is directly subject to pressure from the industrialised world to reduce chemical residues. By virtue of their significant economic power, multinational agrochemical companies are in a key position to affect agrochemical use in the sugarcane-producing developing countries. Companies can either aggravate the dependence of sugarcane-producing developing countries on high-input agriculture, but they can also be a highly positive force in fostering appropriate use of agrochemicals and alternative management practices, through Corporate Social Responsibility schemes, for example.



Developing countries often lack the required legal and scientific expertise as well as the human and financial resources needed to conduct risk assessments and to implement and enforce chemicals regulation. Chemicals registration procedures in these countries, when such procedures exist, often are not based on data on the prevailing local conditions. Instead, assessments draw on information from the developed world, which tend to make assumptions about 'best practices' and environmental conditions that are unrealistic in the developing world.

This report presents examples of the challenges of agrochemicals use in sugarcane production in Nicaragua, Fiji, and Brazil in order to illustrate some of the intimate links between agrochemical use and the dynamics of competition in the world market. The competitiveness of Brazilian sugarcane production is partly based on the low wage labour and modest investment in environmental protection. However, to ensure continued access to export markets, the country is under increasing pressure to demonstrate adherence to socially and environmentally appropriate production practices. The problems of inappropriate chemicals use in the Nicaraguan sugarcane production partly stem from the country's economic development model driven by agricultural exports, yet international pressure has not so far been sufficient to ensure effective Corporate Social Responsibility schemes in the country's sugar sector. The Fijian case shows how the progressive removal of the EU preferential treatment to the country's sugar exports has, paradoxically, opened up a 'niche' for environmentally and socially more benign production methods.

### **Reasons for inappropriate agrochemicals use**

Major reasons for farmers not respecting the good practice in chemicals application include the following:

- Workers do not use appropriate equipment
- Chemicals are applied at a wrong moment in time, in inappropriate ways, too often or in excessive amounts
- Outsourcing the application of pesticides sometimes allows companies to evade their social and environmental responsibilities
- Storage containers are handled, stocked and traced inadequately
- Persons handling chemicals lack sufficient training and information on the associated hazards and appropriate user practices
- Legislation for chemical control and occupational health is lacking or inappropriate
- Chemicals approval and registration procedures are lacking, inadequate, or poorly implemented and enforced
- Government subsidies keep the price and availability of agrochemicals artificially low
- Farmers mistrust the experts and their advice on chemicals hazards

## International action in the area of agrochemicals use

International initiatives to reduce the harmful impacts of chemicals include the Rotterdam Convention on Prior Informed Consent (PIC), the Stockholm Convention on Persistent Organic Pollutants (POPs), the new European chemicals legislation (REACH), and the civil-society initiated Pesticide Action Network (PAN). A number of international voluntary initiatives have been specifically geared towards promoting socially and environmentally more responsible sugarcane production. The most significant among such initiatives include the following:

- International Code of Conduct on the Distribution and Use of Pesticides
- Code of Practice for Sustainable Cane Growing in Queensland
- South African Sugar Association's Manual of standards and guidelines for conservation and environmental management in the sugar industry
- Principles and General Criteria for Social and Environmental Certification Imaflora/SAN of the Sugarcane Culture (Brazil)
- Fairtrade Labelling Organisation (FLO) criteria for sugarcane
- Ethanol and Sugar Impact Analysis (ESIA)
- Better Sugarcane Initiative
- Roundtable of Sustainable Biofuels
- UK Renewable Transport Fuel Obligation

Numerous certification schemes are currently in use or under development to ensure the sustainability of biofuels, including ethanol produced from sugarcane. While certification can be a powerful tool for promoting more appropriate use of agrochemicals, poorly designed certification schemes may constitute an obstacle to small farmers' market access and they may serve to legitimise unsustainable production methods. Active measures are needed to ensure that the weakest actors have access to, and the necessary resources to contribute to the design of international certification schemes.

Among the most promising and rapidly increasing expanding for reducing the harmful impacts of agrochemical use in sugarcane cultivation is Integrated Pest Management (IPM), which seeks to foster the growth of a healthy crop with the least possible disruption to agro-ecosystems and privileges natural pest control mechanisms over chemicals use. Promising IPM strategies have been developed in many countries and regions, including the South Pacific, Brazil, India and South Africa. A further step forward would be the adoption of organic farming methods. The São Francisco mill in the state of São Paulo has indeed demonstrated that organic sugarcane cultivation can be viable even at a large-scale.

Major controversies surround efforts to develop transgenic sugarcane, aimed for instance at developing herbicide-resistant sugarcane varieties. Views diverge on whether genetic engineering indeed reduces or rather increases agrochemical use, and the public opinion on genetically modified sugarcane remains divided. Any efforts to develop such cane varieties therefore need to be carefully monitored and underpinned by broad participation of all relevant actors.



## Adopting best practices

To foster better use of agrochemicals in sugarcane cultivation, further work is needed to implement the recommendations of the International Code of Conduct on the Distribution and Use of Pesticides. Remedying the chronic problem of poor implementation and enforcement in the developing countries requires strengthening these countries' institutional capacities, notably through training of regulatory agency personnel, establishment of laboratories for risk assessment, as well as the provision of financial resources, farmer training and education. Such efforts should build on bottom-up strategies and collaboration among all parties involved, not least in order to build trust between the farming community and the experts providing advice on chemicals use.

The governments in the developed world should assist developing country governments to improve their chemicals registration, control and enforcement procedures. The chemicals industry, in turn, has a key role in promoting the use of alternative, less harmful pest management practices, providing training and information to chemical users, as well as actively collaborating with governments and stakeholders when implementing adequate risk assessment and chemicals regulation procedures.



# Introduction

While the introduction of agricultural chemicals has allowed spectacular crop yield increases in practically all areas of agriculture, this progress has not come without cost for human health and the environment. Inadequate use of agrochemicals is particularly problematic in developing countries, which often lack the sufficient institutional conditions to ensure that these chemicals are used safely, without endangering workers health, or contaminating the environment. The generally warm and humid climates prevalent in most developing countries tend to aggravate pest problems and thereby increase the need for agrochemicals use. The institutional problems are highlighted by the fact that while developing countries consume only 20% of global agrochemicals, as much as 70% of intoxication cases occur in these countries (de Miranda et al. 2007, 11). The WHO has estimated that, in the 1990s, between three and five million people in the world suffered from agrochemicals contamination each year (de Miranda et al. 2007, 11). ILO (International Labour Organisation) studies suggest that pesticide misuse causes 14% of occupational injuries in agriculture and, in some countries, as much as 10% of fatalities (Brodesser et al. 2006).

Sugarcane cultivation does not require chemical inputs higher than average – in fact, the use of insecticides and fungicides is below the average for comparable cash crops. Nevertheless, chemical use presents significant challenges also in this sector mainly because sugarcane is primarily grown in developing countries. Among the world's ten largest producers, eight are developing or emerging countries, with Brazil and India the leading producers. Australia (8th) and USA (10th) are the only industrialised countries among the top ten.

In the 1960s, the so-called Green Revolution sought to export to the developing world the model of intensive industrialised agriculture, which had expanded in the developed countries in the early post-War era. As part of this effort to increase yields, many governments in the developing countries encouraged and promoted the use of agrochemicals as a means to increase yields per hectare, through measures such as farmer extension services and subsidies (Dasgupta et al. 2007; Silva et al. 2005, 895). Especially in many Asian countries, the high-input intensive agriculture indeed produced at times remarkable results in improving agricultural output (e.g. Evenson and Gollin 2003). However, while the limitations and the potentially harmful socio-economic and environmental impacts of such high-input agriculture have been increasingly recognised, reorienting governments support policies accordingly has proven a slow process (e.g. Pretty 1998). Governments frequently continue to subsidise the use of agricultural inputs, thereby providing farmers an incentive to overuse cheap agrochemicals. Agricultural extension programmes tend to promote high-input farming methods, and extension workers may lack knowledge and expertise in alternative cultivation methods.

However, there has been an increasing recognition by governments, industry and farmers about the need to minimise the harmful impacts of agrochemicals, by eliminating unnecessary use, and by promoting good management practices. Some of the means for minimising the need for chemical inputs are technical. For instance Brazil has implemented ambitious programmes of plant breeding and genetic engineering, with reduced needs for chemical inputs in sugarcane farming as one of its main objectives. Countries likewise collaborate to harmonise chemical

legislation and regulation, with the European “REACH” legislation among the most recent experiences. However, perhaps the most concrete examples have been the multistakeholder efforts aimed at finding practical solutions to resolve problems associated with agrochemical use. Such efforts are increasingly part of companies’ Corporate Social Responsibility schemes.

This report provides an overview of the main problems and challenges in the use of agrochemicals in sugarcane cultivation. It starts by a brief introduction to the most common agrochemicals used and their potential harmful impacts on human health and the environment. The paper then illustrates these challenges through three case studies in Nicaragua, Fiji and Brazil. The following section summarises the regulatory situation concerning the main herbicides used in sugarcane, whereas the last section looks at possibilities to alleviate the problems. It should be underlined that the scope of this paper is restricted to the problems associated with agrochemical use. While fully recognising the benefits of agrochemicals in enhancing crop yields and reducing crop losses, it does not address these benefits in any detail. Neither does the paper examine other environmental and health hazards associated with some forms of sugarcane production, such as the water pollution caused by effluents from the sugar and ethanol factories, use of child labour, loss of biodiversity, potential competition with food crops caused by the expansion of the area under sugarcane cultivation, or problems of concentration of landownership (e.g. Smeets et al. 2008).

# 12 Impact of agrochemicals : Human health and Environmental impacts

Most agrochemical-related health concerns in sugarcane cultivation stem from the exposure of field workers to herbicides. Compared to many other commercially cultivated crops (e.g. soybean or cotton), sugarcane requires relatively little use of other pesticides, with insecticides being applied only to a limited extent. This is important, since most acutely toxic chemicals are usually insecticides and fungicides (Szmedra 2002). Pesticide requirements have been further greatly reduced through breeding, genetic engineering and the development of biological control, which have been privileged in crop protection programmes for many years.

## Human health

Field workers can become exposed to farm chemicals at three main stages of the production process: the application of the chemicals in the field, the preparation of the chemical mixtures, and the treatment and storage of seeds and cuttings. The health effects from this exposure can be divided into acute and chronic impacts. The former include skin problems, respiratory problems, and intoxication causing bleeding, convulsions, nausea, vomiting, and in the worst cases death. Potential impacts from long-term exposure include increased cancer risk, neurological symptoms, endocrine disruptions, weakening of the immune system, genetic mutations, and behavioural changes. While acute poisoning cases are relatively common in developing countries, acute toxicity of chemicals is easy to establish, and the harmful impacts are in principle relatively easy to avoid by adhering to proper measures of application. Establishing the contribution of agrochemicals to chronic illnesses from long-term exposure, by contrast, is considerably trickier and a subject of frequent controversy and disagreement even among scientific experts. A key challenge is identifying the causal relationships between exposure to agrochemicals and the potential health and environmental impacts in a situation where humans and ecosystems are continuously exposed to multiple stressors, including chemicals from different sources. As a rule, farm workers are simultaneously exposed to a number of different chemicals, with potential synergistic or accumulating impacts (Barlow et al., 2003; 2004; Cicchetti et al., 2005; Prasad et al., 2007; Thiruchelvam et al., 2000; Silva et al. 2005).

The degree and type of health impacts is influenced by individual characteristics such as the general health and nutritional status of the individual, as well as by behavioural aspects such as smoking and alcohol use (Arroyave 1990; Silva et al. 2005, 898; Dasgupta et al. 2007). The impacts of agrochemicals also tend to be greater at higher temperatures, which increase both the rate of blood circulation and the absorption of chemicals through the skin (e.g. Weinbaum et al. 1995). Particularly relevant for sugarcane workers is that the relatively high intensity of their work effort increases the rate of respiration, and thereby also the rate at which chemicals are being inhaled (Silva et al. 2005, 898).



**Table 1. Potential health impacts of inappropriate agrochemical use (adapted from Silva et al. 2005, 899)**

	Short-term exposure	Long-term exposure
Acute symptoms	Nausea, headaches, vomiting, dizziness, paresthesia, respiratory problems, coma, death	Bleeding, hypersensitivity, teratogenic effects, fetal death
Chronic symptoms	Reversible paralysis, irreversible neurotoxic effects, pancytopenia (deficiency of red and white blood cells)	Irreversible brain damage, malignant tumours, testicular atrophy, male sterility, behaviour disorders, neurological problems, skin allergies, formation of cataracts, atrophy of optic nerves, kidney damage, etc.

Beyond these physical factors, the health impact of agrochemicals depends on the broader socio-economic context, such as the farm practices and social relations in the working environment, strategies of agrochemicals use, measures undertaken to limit harmful impacts, and workers' risk perceptions (Silva et al. 2005). Health problems caused by agrochemicals use in developing countries tend to be systematically underreported in national statistics, partly because of poor access of farmers to health services, weak capacity of public health personnel to identify and deal with health problems associated with agrochemical use, and the lack of monitoring laboratories (Murray et al 2002; London & Bailie 2001; Silva et al. 2005,; Wessling et al. 2005).

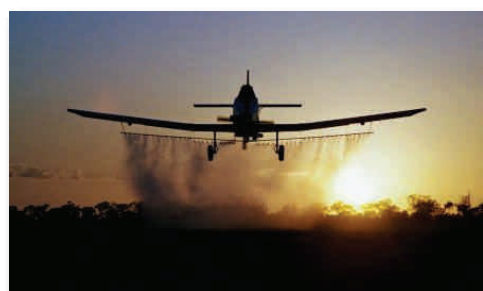
### Environmental impacts

Beyond their effects on human health, key environmental impacts of agrochemicals include surface and groundwater pollution and soil contamination. On the one hand, problems are of local and social nature, since the local inhabitants typically obtain their drinking water either from rivers (which are not treated and therefore able to capture pesticide residues) or from groundwater underneath sugarcane plantations (Veiga Filho 2008). On the other hand, the problems have a global character, because toxic compounds accumulate in the food chain and are found even in the pristine Polar Regions (Blais et al. 1998). Inappropriate chemical control can also destabilise the balance between organisms in the fields (i.e. between pests, their predators and parasitoids), leading to the proliferation of pests that later cause significant damage to the sugarcane and yield reduction (Cheesman 2005, 45).

While the health and environmental impacts often act in the same direction – efforts aimed at reducing one also help to alleviate the other – sometimes there is a clear trade-off between health and environmental objectives. A typical example is the way in which concerns for the residues of

persistent organic pollutants (POPs) in food products have led to their progressive replacement by the less persistent carbamates and organophosphates such as Glyphosate. While less persistent in the environment, the new chemicals have a far higher acute toxicity level, and therefore pose very serious health hazards to farmworkers, farmers, and rural residents (Galt 2008).

In summary, assessing the health and environmental hazards caused by pesticides is highly complex, and involves disagreements not only between different stakeholders, but also among scientific experts. The recent arduous negotiations leading to the adoption of the European chemicals legislation ("REACH") were but an example of the issues at stake. Disagreements frequently concern different perceptions of risk and the varying interpretation of the so-called precautionary principle. Stakeholders therefore frequently disagree on who should bear the 'burden of proof', i.e. whether the industry should demonstrate that its products are proven safe – with a reasonable degree of certainty – or whether instead anyone opposing the introduction of a chemical substance on the market should be able to demonstrate scientifically proven link between exposure to the substance and its alleged harmful impacts.



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# International action on agrochemicals

Several international initiatives have been taken to reduce problems associated with the use of agrochemicals. Among the most significant are the Rotterdam Convention on Prior Informed Consent (PIC), the Stockholm Convention on Persistent Organic Pollutants (POPs), the new European Community Regulation on chemicals and their safe use – REACH (EC 1907/2006), and the civil-society initiated Pesticide Action Network (PAN).

The Rotterdam Convention, which entered into force in February 2004, seeks to regulate international trade of hazardous chemicals and promote exchange of information between countries on such chemicals. It creates legally binding obligations for the implementation of the Prior Informed Consent (PIC) procedure. If two or more countries in a PIC region ban or severely restrict a chemical, a committee reviews the evidence to decide whether the chemical should be on the PIC list. The Convention and its preparation have been important in providing a structure for the work of advocacy groups in the developing countries. PIC list now contains 24 active ingredients for which importing countries must be notified. However, PIC only refers to internationally traded chemicals, and does not account for the fact that the harmfulness of agrochemicals varies according to the conditions in which they are being used (Galt 2008, 788-789). In particular, risk assessments based on 'best practice' conditions in developed countries are often of little value in developing countries, where such conditions are unlikely to be met (e.g. Wessling et al. (2005).

The Stockholm Convention on Persistent Organic Pollutants (POPs) also entered into force in 2004. It identified twelve chlorine-based POPs, the so-called "Dirty Dozen", as targets for a global phase-out effort. The total POPs list contains nine pesticides (in bold below), seven of which are also on the PIC list (Galt 2008, 789; <http://www.unido.org/index.php?id=o29428>):

PCBs, Dioxins, Furans, Aldrin, Dieldrin, DDT, Endrin, Chlordane, Hexachlorobenzene; Mirex, Heptachlor, Toxaphene.

As of May 4, 2009, 162 countries and the European Union had ratified or acceded to the Stockholm Convention on POPs. Notably, the US had not yet ratified the convention by that date. (<http://www.uspopswatch.org/index.htm>)

The EU's so-called REACH Regulation sets up a system under which a number of Substances of Very High Concern (SVHCs) are identified and their placing on the market and use may be subject to prior authorisation. REACH aims at ensuring proper control of risks from SVHCs and promoting their progressive replacement by suitable alternative substances or technologies, whenever economically and technically viable. Typical candidates for the REACH list are SVHCs that are carcinogenic, mutagenic or toxic to reproduction, persistent, bioaccumulative and toxic, or very persistent and very bioaccumulative, but further substances can also be identified and placed on the list on the basis of a case by case evaluation. (ECHA 2009) The European Chemicals Agency (ECHA) agreed in October 2008 on the first list of 15 SVHCs, which will undergo closer scrutiny. The list will be updated regularly.

Among NGO actions, perhaps the most ambitious and widespread one is the establishment of the Pesticide Action Network (PAN) in 1982 to work for the replacement of the use of hazardous pesticides with environmentally and socially less harmful alternatives. PAN includes over 600 NGOs, institutions and individuals in over 90 countries, and relies on its five independent, collaborating Regional Centres to implement its projects and campaigns.

<http://www.pan-international.org/panint/?q=en/node/33>



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# 17 Agrochemicals used in sugarcane cultivation

Some of the pesticides most commonly used in sugarcane cultivation are listed below, together with a brief description of their main hazards.

## Hexazinone

- Acutely toxic
- Known and pervasive groundwater contaminant, due to its high water solubility
- Not registered in the EU, but a few uses remain allowed in a handful of European countries

## Diuron

- Groundwater contaminant
- Carcinogen
- Developmental or reproductive toxin
- Registered in the EU, but forbidden since 2008 e.g. in France

## Tebuthiuron

- Developmental or reproductive toxin
- Potential groundwater contaminant
- Not registered in the EU

## 2,4-D (WHO Class II)

- Possible carcinogen, even though the link has not been demonstrated linked to cancer in agricultural workers in the North (Hardell and Sandstrom 1979; Hoar et al. 1986; Hardell and Eriksson 1988)
- Potential groundwater contaminant
- Suspected endocrine disruptor
- The most popular herbicide by volume worldwide in the 1990s (USDA 1996)
- Widely used, e.g. in Brazil's cane cultivation; Silva et al. (2005) report cases in which field workers using 2,4-D complain of memory loss, concentration problems and sleeping disorders that they associate with the use of 2,4-D

## Glyphosate

- Organophosphate, with non-specific effects (non-discriminate)
- Potential groundwater contaminant
- Low acute toxicity and relatively less harmful than many alternatives
- Among the world's most widely used herbicides

## Ametryn

- Potential groundwater contaminant
- Not registered in the EU

### Paraquat

- Gramoxone (Paraquat dichloride)
- Zeneca = basic manufacturer of Paraquat
- Categorised in WHO class II of acute toxicity (moderately hazardous), but some critics have called for an upgrading of Paraquat's toxicity classification. does not give due recognition to Paraquat's absorption through skin. Anti-Paraquat campaigners have argued that the justification for the WHO classification does not sufficiently take into account the greatly enhanced absorption of Paraquat through skin, when skin has been damaged or is covered by clothing contaminated with Paraquat" for a longer time (Garnier 1995)".
- Commonly used as a suicide agent
- Lively debates and disputes have taken place among experts concerning the possible link between Paraquat exposure and Parkinson's disease (e.g. Miller 2007; Cory-Slechta et al. 2008; LoPachin and Gavin 2008; Miller 2008a; 2008b). Epidemiological evidence, indeed, supports a connection between pesticide exposure and Parkinson's disease, but studies have thus far been unable to accurately identify specific compounds responsible for the association (Miller 2007). In other words, it is possible that "Paraquat is responsible for such a link, but epidemiological studies would be needed to establish this with reasonable certainty. The impacts of Paraquat, as those of many other agrochemicals, may be enhanced by exposure to other chemicals, and influenced by environmental and life-style factors; research has also elucidated potentially important mechanisms of interaction (e.g. Barlow et al., 2003 , 2004 ; Cicchetti et al., 2005 ; Prasad et al., 2007 ; Thiruchelvam et al., 2000). Factors that might enhance Paraquat's neurotoxic effects include exposure to the fungicide maneb (Barlow et al., 2003) or neonatal iron exposure (Peng et al., 2007; Cory-Slechta et al. 2008). Animal tests have suggested possible genotoxic impacts (D'Souza et al. 2005), and reproductive disorders (Garcia et al. 1998; Hausburg et al. 2005; Quassinti et al. 2009)
- Environmental groups / anti-Paraquat campaigners call for a ban on the use of the chemical arguing that its correct use in developing country conditions cannot be ensured, its frequent use as a suicide agent, its uncertain long-term health effects, and the availability of less harmful substances and weed control strategies, notably the Integrated Pest Management (IPM) (e.g. Dinham 2005).
- In 2007, EU removed Paraquat from the list of registered chemicals, as a result of a court ruling overturning an earlier EU Commission's decision from 2003 to authorise Paraquat sales. The ban was justified partly on the grounds that Paraquat's harmlessness to humans and the environment had not been properly demonstrated, as well as for procedural reasons (EU 2007; Swissinfo 2007). In particular, the Court argued that the existing evidence raised doubts about the safety of operators, the sufficiency of evidence to conclude that Paraquat had no harmful effect on animal health, and the sufficiency of the preventive measures to reduce the identifiable risks (EU 2007).
- The company producing Paraquat, Syngenta, in turn, contests the claim that the court decision had anything to do with health and safety and argues that the decision was based on only procedural aspects (<http://paraquat.com/english/safety/regulation>)

- In the Annual Regional Health Sector Meeting (RESSCAD) held in Honduras in September 2000, seven ministers of health of Central American countries signed an agreement about banning or restricting the use of 12 dangerous agrochemicals used in the region, including Paraquat, Endosulfan and Terbufos (Wesseling et al. 2005, 702).

#### Endosulfan

- Insecticide
- Suspected endocrine disruptor
- Being assessed for listing by the Stockholm Convention on Persistent Organic Pollutants
- Recommended for listing under the Rotterdam Convention (PIC list)
- Not registered in the EU

#### Metribuzin

- Developmental or reproductive toxin
- Suspected endocrine disruptor
- Potential groundwater contaminant
- Registered for use in the EU

#### MSMA

- Herbicide
- Carcinogen
- Potential groundwater contaminant
- Not registered in the EU

#### Clomazone

- Herbicide
- Potential groundwater contaminant
- Registered for use in the E

#### Imazapic

- Herbicide
- Potential groundwater contaminant
- Not registered in the EU

#### Atrazine

- Herbicide
- Carcinogen
- Groundwater contaminant
- Suspected endocrine disruptor
- Not registered in the EU

#### Acetochlor

- Herbicide
- Carcinogen
- Suspected endocrine disruptor
- Not registered in the EU

#### Terbufos

- Insecticide, nematocide
- Extremely high acute toxicity
- Cholinesterase inhibitor
- Not registered in the EU

#### MCPA

- Herbicide
- Possible carcinogen
- Registered for use in the EU

#### Imidachloprid

- Insecticide
- Potential groundwater contaminant
- Has attracted controversy due to possible detrimental effects upon honey bees
- Under investigation in France and has been banned in Germany for certain seed treatments

#### Chlordecone (source: UNEP 2007):

- Insecticide used mainly in banana plantations to control the banana weevil *Cosmopolites sordidus*
- Indirect impact on sugarcane in the French Caribbean islands (esp. Guadalupe), where banana and sugarcane are frequently cultivated in rotation
- Chemically very similar to Mirex, which is listed under the Stockholm Convention
- Highly toxic to aquatic organisms
- Highly persistent in the environment
- Readily absorbed into the body and accumulates following prolonged exposure
- Both acutely and chronically toxic: according to experimental animal studies, neurotoxic and immunotoxic; produces reproductive, musculoskeletal and liver toxicity
- Possible human carcinogen according to the International Agency for Research on Cancer (IARC group 2B)
- Potential reproductive effects
- Production ceased in developed countries (use forbidden in the early 1990s), but still used in some developing countries
- In Guadalupe and Martinique (French overseas departments) soil pollution caused by previous use of Chlordecone led to restrictions in the use of food products produced on contaminated soils
- Guadalupe (France) has more than 5000 ha of soils polluted due to the use of this insecticide.



# A summary list of the most problematic agrochemicals in sugarcane agro-ecosystems

While most agrochemicals can have serious adverse health and environmental effects when used inappropriately, the following eight chemicals can be identified as the potentially most problematic ones. None of these substances have been registered for use in the EU, and they are on the PAN “bad actor” chemicals list. The following list also mentions the most problematic characteristics associated with each substance.

## Hexazinone

- Groundwater contaminant

## Tebuthiuron

- Developmental or reproductive toxin
- Potential groundwater contaminant

## MSMA

- Carcinogen
- Potential groundwater contaminant

## Paraquat

- Suspected endocrine disruptor
- Potential groundwater contaminant
- Disagreements on the acute toxicity level

## Atrazine

- Carcinogen
- Groundwater contaminant
- Suspected endocrine disruptor

## Acetochlor

- Carcinogen
- Suspected endocrine disruptor

## Terbufos

- Extremely high acute toxicity
- Cholinesterase inhibitor

## Endosulfan

- Suspected endocrine disruptor

# 22 Chemicals registration, safety and global agrochemical politics

Problems and challenges associated with agrochemicals use are intimately linked with the operation of the global pesticides market, which is today dominated by some 20 large multinational companies, with annual sales of about USD 20 billion and total yearly production volume of approximately 2.5 million tonnes (Silva et al. 2005, 895).

Global pesticide problems were until recently often described through the model of the “circle of poison”. This metaphor refers to a system in which chemicals banned in developed countries were exported to developing countries, where they were used almost exclusively in export crop cultivation, and therefore finally returned to the developed countries in the form of chemical residues in food (Galt 2008). However, the growing complexity of the global agrochemicals markets has significantly blurred this picture, and largely rendered the circle of poison hypothesis inadequate. A number of reasons can be evoked to explain this change. Firstly, the demand for the most persistent chemicals, especially the “dirty dozen”, has declined considerably, partly because new alternatives have become available, thanks to the pressure from the civil society (Galt 2008, 790). Secondly, the multinational chemical companies have actually benefited from stricter pesticide regulation, because this has opened up markets for new higher-value added products as the old ones have been banned. Thirdly, many developing countries are no longer mere importers, but also significant producers of agrochemicals – Brazil being a case in point. Agrochemical trade and use therefore increasingly originates and ends in developing countries, unlike the “circle of poison” model suggests. Global chemical regulation efforts are bearing fruit, to the extent that the share of banned, severely restricted, or never-registered pesticides of the US pesticide exports has declined from the approximately 25% in the 70s and 80s to the currently estimated 2% (Galt 2008, 790)

Fourthly, agricultural production in the developing countries has become increasingly polarised between the ‘core’ exporting sectors and ‘peripheral’ domestic markets, the former being highly depended on developed country demand – and thereby on the chemicals legislation in the developed countries – whereas farmers producing for the domestic markets have been increasingly isolated from such pressures. The demand for visually faultless products of uniform shape and quality, which prevailed in the industrialised countries until recently, fostered high-input farming methods that relied on high level of agrochemical use. However, rising concerns about chemical residues in food have forced the developing country exporters to reduce the use of agrochemicals and to shift to less persistent substances. An example of the problems related to such a shift is the way in which, in reaction to US legislation, export farmers in developing countries have had an incentive to shift to pesticides that are less persistent in the environment and products, but much more acutely toxic, such as the organophosphate and carbamate insecticides. This has, in turn, meant greater risks of poisoning to the farm workers in export crop production. The farmers producing for the domestic market have been isolated from international pressures, and continued to use persistent pollutants (Galt 2008, 791)

### North-South trade in chemical registration?

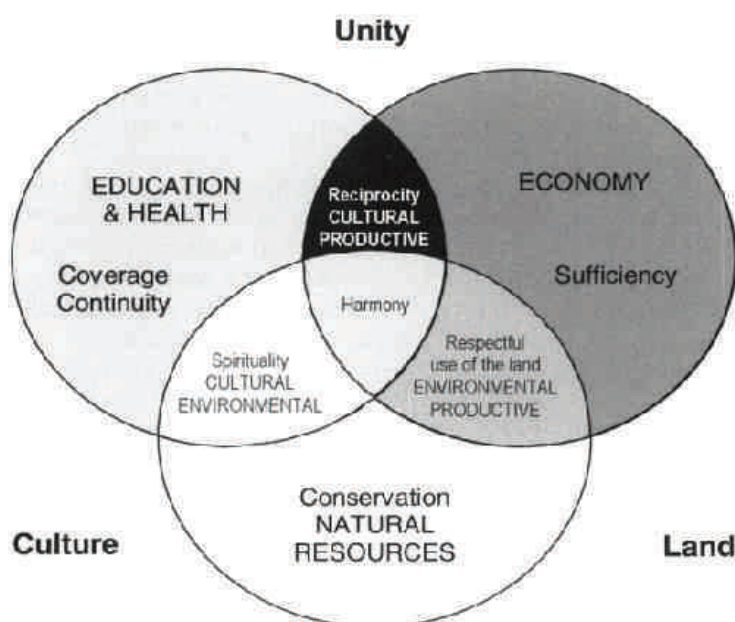
The old assumption that regulation in the developed countries provides a good proxy for the safety of agrochemicals is questionable, for at least two reasons. Firstly, the conditions in which chemicals in northern industrialised countries are tested often do not correspond to those prevalent in the tropical producing regions. Some pesticides can be relatively harmless under the natural and institutional conditions prevailing in the developed countries, but can be far more hazardous in developing countries (Galt 2008, 788-789). The chemicals registration procedures in developing countries, if such procedures exist, seldom rely on actual exposure data, which would allow proper risk assessments by taking into account the true conditions and prevailing local practices in the targeted country. Instead, developing countries most often rely on assessments made in the developed countries, which frequently assume that 'best practices' of pesticide application are adhered to – which frequently is not the case. (Wesseling et al. 2005). Hence, for instance the judgement by the EU Commission in 2003 to approve the use of Paraquat within the Community (revoked in 2007) was premised on the condition that "appropriate risk-mitigation measures and restrictions are applied" (EU 2007).

As suggested above, judgements and regulatory decisions on the safety of agrochemicals are not taken merely on an 'objective' scientific basis. Experts often disagree on safety thresholds and decisions are always affected by considerations relating to economics, politics, risk perceptions, interpretation of the precautionary principle, industrial structure, etc. Indeed, Galt (2008, 793) notes that almost one-third of the 325 pesticide active ingredients registered in the US were suspected of playing some role in causing cancer, another third was suspected of disrupting human nervous system, while the rest were potential endocrine disruptors. Yet this does not mean that all of these authorised chemicals would be harmful, if used properly, with appropriate precautionary measures in place.

Uncertainties also relate to the extent to which laboratory studies provide reliable information on the behaviour and impacts of chemicals in outdoor conditions and in 'real world' practice. When proper management practices and protective measures are not in place, the real-life impacts of agrochemicals can be dramatically more serious than laboratory studies would suggest. Sometimes the situation is the reverse, as illustrated by a study of the impacts of the herbicide Metribuzin on freshwater flora and fauna. Fairchild and Sappington (2002) suggest that while Metribuzin is highly toxic to freshwater macrophytes and algae under laboratory conditions, it does not cause significant damage to aquatic life under controlled outdoor conditions, mainly because of its short half-life.

Political, institutional and cultural factors further complicate the picture. In their study concerning pesticide registration procedures in the Central America, Wesseling et al. (2005) noted that pesticide registration tends to be, by law or in practice, the responsibility of the ministries of agriculture, while the ministries of health, labour and the environment have only a marginal role (see also Wesseling et al. 1997; Madrigal 2001). In practice, this often implies that the experts at the ministries of agriculture tend to align with the pesticide and agricultural industry, and favour chemical pest

control over alternative methods (Wesseling et al. 1997; Contraloría General de la República 2004). Chemical registration in developing country administrations is frequently in the hands of a limited number of professionals, who may not have the necessary expertise for the task (Wesseling et al. 1997). Wesseling et al. (2005, 702) also note that the harmonisation of registration processes across countries (e.g. Central America) may in fact facilitate uncontrolled pesticide trade. Furthermore, the increasingly common practice of allowing generic pesticides to be registered without the need to present the data that the law requires for newly registered pesticides facilitates pesticide imports of unknown origin and dubious quality (Contraloría General de la República 2004).



# Examples of inappropriate use of agrochemicals

## Nicaragua : Chronic kidney failure (CKF) and agrochemical used in sugarcane fields

In Nicaragua, the San Antonio sugar mill, owned by the Nicaragua Sugar Estates Ltd., has been brought to justice for having caused the premature death of thousands of sugarcane harvest workers, due to the wrongful or negligent use of different herbicides and pesticides. The Chronic Renal Insufficiency (CRI), presumably induced by agrochemicals exposure, has been pointed out as the death cause. Information from the Nicaraguan association set up to defend the rights of the people suffering from the disease (Asociación Nicaragüense de Afectados por Insuficiencia Renal Crónica – ANAIRC), an affiliate of the International Union of Food, Agricultural, Hotel, Restaurant, Catering, Tobacco and Allied Workers' Associations (IUF), reports that the total number of people who have died as a result of Chronic Renal Insufficiency (CRI) as of March 22, 2009 was 3,251, and that from March 14, 2005 to March 22, 2009 alone, 2,244 people died from this disease. (ANAIRC 2009)

In addition to the deaths, thousands of harvest workers are currently afflicted with CRI, allegedly because of pesticide exposure. The disease entails a gradual and progressive loss of the ability of the kidneys to excrete wastes, concentrate urine, and conserve electrolytes. This process usually lasts several years, during which the internal structures of the kidney are slowly damaged. The victims have been usually been diagnosed at a stage at which it would be too late to conduct a kidney transplant. Moreover, the diseased are usually poor, and live in a rural area, therefore lacking the opportunity to receive dialysis treatment. Moreover, a significant amount of workers have, presumably wrongfully, been denied their disability pension benefits essential for their own and their families' survival. (IJM 2007)

The list of the chemicals used in the fields and suspected for having caused the illness include the herbicides Glyphosate (RoundUp), Hexazinone, Ametryn, Karmex DF, Paraquat (Gramoxone), the rodenticide Warfarin, and the insecticides Terbufos and Cypermethrin (IJM 2007).

San Antonio is a national company, which produces almost all of the sugar consumed in Nicaragua, and also exports both sugar and sugarcane ethanol, both to Europe and the US. (Iglesias 2009; Frey 2008). The company has been accused of concealing information about the use of agrochemicals in its exploitations, and for violating Nicaraguan labour legislation (Frey 2008). The association set up to defend the rights of the victims, ANAIRC (Asociación Nicaragüense de Afectados por Insuficiencia Renal Crónica), has organised a number of demonstrations, but have also filed several lawsuits against the company. However, the police and the authorities have sought to prevent farmers from demonstrating, and the lawsuits have failed to produce results favourable to the victims, and the police has been accused of violently repressing the protests.

The case is complicated by the fact that Carlos Pellas, the President of Nicaragua Sugar Estates, is one of the richest and most influential men in Nicaragua, with close contacts with the country's political elite. Moreover, Pellas and his wife are major philanthropists and therefore popular figures in the country's political life. Thanks to his central position in networks of power, and his

popularity in the country, Pellas will probably be able to delay the case. Moreover, the Nicaraguan courts and judges may lack the expertise needed to adjudicate in the highly complex case, notably since the company will probably argue that the injuries had other causes than the agrochemicals applied in its operations. (IJM 2007)

The San Antonio plant received in 2006 a USD 55 million loan from the IFC (International Finance Corporation), World Bank's private sector financing arm. Local communities subsequently joined their efforts and filed a complaint with the Compliance Advisory Ombudsman, the IFC's internal auditing office. They called for the IFC and the World Bank to pressurise the Nicaragua Sugar Estates to abide by the environmental and labour regulations of Nicaragua and the IFC's own regulations. (Frey 2008)

The San Antonio case is still pending and doubts have been raised about the veracity of the claims made by the workers. Reference has been made to the similar, apparently fraudulent court cases brought against the Dole and Dow Chemical Company by former workers in the company's banana plantations in Nicaragua in the 1970s (e.g. Kay 2009; Oray 2009). Some have suspected that the activists speaking in favour of the victims do so in search of personal economic gain and have contested the link between CRI and the pesticides used in sugarcane plantations, referring to studies concerning the prevalence of CRI among the populations in the two Nicaraguan regions in question.

Others, such as Julio Sanchez from the Humboldt Centre, consider the case of San Antonio within the broader context of the export-oriented model of Nicaraguan agro-industry. As a result, the imperative of export-led economic growth would have overridden other considerations, notably the environmental and social problems. The problems have been compounded by conflicts over the competences and lack of coordination between agricultural, environmental and health authorities responsible for the control and monitoring of agrochemicals use, and enforcement of legislation. The failures to solve these conflicts, in turn, have led to illegal trafficking, as well as mishandling and illegal storage of agrochemicals. The ministry of agriculture is being blamed for its excessively lenient position in relation to chemical importers and producers, as the ministry allegedly argues that chemicals are needed to boost economic growth.

Nicaraguan legislation has banned 17 agrochemicals from use, most of which are nevertheless still used illegally. Furthermore, of the so-called Dirty Dozen pesticides, only one has been banned – because it was no longer imported – while the use of the others is regulated, but allegedly in an excessively lenient manner.

One problem identified in Nicaragua, but which is typical for developing countries in general, is the lack of appropriate measures for governing the storage and disposal of agrochemicals (e.g. Brodesser et al. 2006; Ecobichon 2001). In Nicaragua, a company can bring chemicals into the country, distribute and sell them, without having the responsibility to dispose of the stored products. This task of disposing of and storing the chemicals falls upon the State. In practice, the prod



ucts are often stored in unsuitable warehouses, from which the toxic substances frequently leak and spill to the environment. The Aquatic Resource Research Centre (CIRA) has, according to Julio Sanchez, established clear evidence for contamination caused by the Nicaragua Sugar Estates (Guevara Jerez 2007).

### **Fiji: Organic sugarcane cultivation as a strategy for survival and sustainability**

Sugarcane cultivation in Fiji is strictly a smallholder, family farming enterprise (Szmedra 2002). Yet, it has great economic importance for the country, being the second-most important source of export revenue (next only to tourism), and employing 40 000 people (Rockamann 2007). A survey concerning agrochemical use by the Fijian sugarcane farmers (Szmedra 2002) found that the level of agrochemical use is relatively modest: only about 40% of sugarcane farmers use herbicides to control weeds, while the use of insecticides and fungicides is very rare. Unsurprisingly, given the resources needed for the purchase of chemical inputs, the farms using herbicides were found to be considerably larger than average. A total of 20 agrochemical products were used by farmers, the most common being 2,4-D, which was used by 89% of farmers. Diuron, Paraquat and MCPA were also in frequent use, while Glyphosate was only applied by about 5% of farmers.

The survey concuded by Szmedra (2002) revealed that the use of multiple protection devices such as gloves, overalls, and boots was surprisingly high – 85% – among the farmers polled for the study. Most (79%) also had concerns about the impacts of using pesticides, but believed the benefits outweighed the risks. An indication of the harmful impacts of the chemicals was that chronic eye, skin and neurological problems, as well as respiratory problems were more common among those who used herbicides than those who did not. Smallholders usually had the least information about the dangers of herbicides (Rockamann 2007).

With the abolishment, on the 1st October 2009, of the EU Sugar Regime, which afforded Fiji and 18 other African and Caribbean countries preferential price treatment in the European markets policy, Fiji will have to adjust to competition in the world markets with all other sugar-producing countries (Serrano 2007). In such a situation, the desire to develop alternative niche markets as a “survival strategy” partly contributed to the setting up of a project to promote organic sugarcane farming in the country. The ‘Fiji Organic Project’, run by the Earth Island Institute, seeks to promote sustainable agriculture, targeting in particular the growing market for organically produced sugar in the US (Rockamann 2007).

The Fiji Organic Project brings together a broad range of stakeholders through three stages: research & planning, training & implementation, and certification & market entry. The project, based at the Sugar Research Institute (SRI) of Fiji, places special emphasis on training, which covers the entire duration of the project. An example of the collaborative and training-oriented approach is the process whereby Fijian graduate students from the University of the South Pacific conducted together with local professionals a multi-pronged feasibility study for organic sugar cane industry. The results of the study were discussed in a stakeholder workshop including participation by

environmentalists, tourism officials, NGOs, cane farmers, researchers, as well as industry and marketing representatives.

<http://www.zimbio.com/All+Things+Eco/articles/50/The+Fiji+Organic+Project>

### **Brazil: Groundwater contamination and public health**

Unlike in Fiji, the majority of sugarcane cultivation in Brazil takes place on large-scale plantations, providing cane both for sugar and ethanol production. Brazil has built its entire growth model on export agriculture and large-scale monoculture farming, whose competitiveness rests partly on low salaries, intensive use of agrochemicals, and advanced programmes for cane breeding. As much as 85% of the cultivated area in Brazil is devoted to sugarcane, soy, and coffee, while around ten international multinational enterprises control practically the entire agricultural production, as well as the provision of agrochemicals and seeds for Genetically Modified crops. (Stedile 2007)

Brazil is the world's leading sugar producer and the world's second-largest producer of ethanol, with more than a half of Brazilian sugarcane coming from the state of São Paulo. Sugarcane occupies 0.6% of the country's land area, which equates to about 2% of the total agricultural area, but in São Paulo state these figures are 18% and 22%, respectively (Smeets et al. 2008, 786-787).

Partly as a result of the central role that large-scale export agriculture plays in the country's economy, Brazil is among the three largest agrochemicals consumers in the world (Monteiro et al. 2008). Agrochemicals use per hectare reached 3.2 kg in 2001, placing the country at the eight place in terms of the intensity of agrochemical use – but the first non-European one (Silva et al. 2005, 895). The use of agrochemicals in Brazil has accelerated especially during the past two decades: in the 1990s, their consumption grew by almost 400% and spending on agrochemical imports increased six-fold, while cultivated area increased only by 7.5% (de Miranda et al. 2007, 11). This trend has persisted since 2000, with agrochemical sales up by an average of 245% between 1999 and 2005. Moreover, Brazil is also a major producer of agrochemicals, with a production volume of 250 000 tonnes in the early 2000s (Silva et al. 2005).

The growth of agrochemical use has been particularly rapid in sugarcane cultivation: 355% over the period 1999-2004 (Hirata 2006). Until the launch of the national ethanol fuel programme in 1975, only about half of the area planted by sugarcane in Brazil was treated by herbicides (Smith et al. 2008, 194). However, the use of agrochemicals in sugarcane cultivation is well below those of many other comparable crops, such as corn (40% less) and coffee, citrus crops and soybean (-90%) (Smeets et al. 2008, 785).

More than 80% of agrochemicals used in Brazilian sugarcane cultivation are herbicides, with insecticides accounting for only around 10% of total use (Armas and Monteiro 2005, 976). While total agrochemical use in sugarcane cultivation has decreased, thanks to biological pest control, plant breeding and genetic improvement, herbicide use still exceeds the levels typical in coffee and corn cultivation and equals those in soybean farming (Macedo 2006, 32). There are also

some examples of cases where farmers that have made the move to biological pest control have reverted back to the routine use of insecticides after temporary failures of the biological methods (Vian et al. 2006, 14).

Today, four chemicals, Ametryne, Tebuthiuron, Hexazinone and Simazine constitute about 80% of all herbicide use on sugarcane in Brazil, while Isoxaffutole, Clomazone, Atrazine, MSMA, and 2,4-D make up the rest (Smith et al. 2008, 194). The state of São Paulo was responsible for nearly 20% of Brazilian agrochemical consumption in 2003 (Armas et al. 2008, 1119), with six products accounting for approximately 85% of total herbicide use: Glyphosate, Atrazine, Ametryne, 2,4-D, Metribuzin, Diuron, and Acetochlor (de Armas et al. 2005, 980). Some of these chemicals, notably Atrazine, are currently not registered in the EU (Smeets et al. 2008, 785). Another chemical still used in Brazilian sugarcane cultivation, but not registered in the EU is the insecticide Endosulfan (Silva et al. 2005, 901).

Use of these agrochemicals has caused severe water pollution especially in areas with intensive large-scale sugarcane cultivation, such as the watershed area of Corumbataí River (Monteiro et al. 2008). However, this is not only an environmental problem, but also directly affects the health of local residents, who rely on contaminated surface and groundwater resources for their drinking water supply (Veiga Filho 2008, 7).

The extent to which agrochemicals reach groundwater and soil depends largely on the prevailing climatic conditions (e.g. temperature, rainfall patterns) and soil characteristics (e.g. the degree of bacterial activity in the soil, type and acidity of the soil). Contamination tends to be highest during the rainy season, and in areas where the soils are relatively permeable. Furthermore, high organic matter content in soils likewise favours the adsorption of chemical compounds, and thereby increases their harmful impacts. (Monteiro et al. 2008) The main herbicides used in sugarcane agroecosystems persist as long as two years in the soil, thereby representing a major risk to aquifers and rivers (Vian et al. 2006, 15).

The most problematic chemicals in the Corumbataí River basin have been herbicides of the triazine group, which were detected in concentrations well above the limits stipulated by the Brazilian federal and São Paulo state legislation (Monteiro et al. 2008; Armas et al. 2007). The use of triazines, such as Atrazine and Ametryne, has recently been expanding in Brazilian sugarcane areas. Ametryne was detected in concentrations as high as ten times the accepted safety levels. Despite its high aquatic toxicity, atrazine use is not restricted in Brazil (Armas et al. 2007). Glyphosate and its metabolite AMPA were likewise commonly detected in Corumbatai (Monteiro et al. 2008).

Apart from the harmful effects on the aquatic fauna and flora, water pollution by agrochemicals use in sugarcane production has been shown to cause serious health impacts in Brazil. For example, an estimated 700 cases of poisoning and 15 deaths were attributed to agrochemical use in sugarcane farming in 1998 (Smeets et al. 2008, 797). In the agricultural sector as a whole, the Ministry of Health estimated that in 2003 the total number of agrochemicals poisoning cases in

Brazil reached 8000, of which 30% in rural areas (de Miranda et al. 2007, 12). However, de Miranda et al; (2007, 12) argue that these statistics are likely to underestimate the problem, because they are based on reporting by local safety authorities, located in urban centres. The authors therefore estimate the real number of annual intoxication cases to exceed 500 000, including some 4000 deaths. Moreover, these data only refer to acute cases, and do not take into account chronic effects.

Poor compliance with legislation has been identified as a major impediment to better use of agrochemicals and the protection of workers' rights in Brazil (Smeets et al. 2008, 797). A manifestation of such compliance problems was the detection of organochloride compounds in the sediment and fish samples collected in the Piracicaba river basin in 1997, despite the fact that these chemicals had been forbidden in Brazil as early as 1985 (Martinelli and Filoso 2008, 888). Poor enforcement of legislation does not necessarily result from mere lack of will, but also from the chronic methodological, material and human resource limitations within the Brazilian labour ministry, responsible for the implementation and enforcement of regulations pertaining to agrochemicals use. The problem of poor law enforcement has been compounded by the lack of information concerning especially the long-term health effects from exposure agrochemicals. (Silva et al. 2005, 895).

### **Conclusion: agrochemical problems in the context of the world market**

Each of the cases of Nicaragua, Fiji, and Brazil has demonstrated some of the ways in which agrochemical use is intimately linked with the dynamics of competition in the world market. The competitiveness of Brazilian sugar and ethanol production has been partly based on the low wage level and on relatively low level of investment in environmental protection (Alves 2006). However, as a major sugarcane exporter, the country is also under increasing pressure to demonstrate that social and environmental aspects are given due attention in the production process. The problems in Nicaragua, in turn, also partly stem from the country's economic development model based on agricultural exports, yet the international pressure on Nicaraguan industry to implement effective Corporate Social Responsibility schemes seems so far to have been insufficient to remedy the problems. Finally, the Fijian case shows how, paradoxically, the inability to compete in world market can open up a 'niche' for production methods more benign to the environment and human health.



**Status report on sugar cane  
agrochemicals management**

**ETHICAL-SUGAR**

# Reasons for “bad practices” of agrochemical application

For a number of reasons, the guidelines of ‘good practice’ in the application of agrochemicals in sugarcane cultivation are frequently overlooked especially in the developing countries. On a general level, the reasons relate to economics, lack of training and information, absence of appropriate legislative and regulatory frameworks, and the chronic lack of manpower and financial resources needed to implement and enforce legislation. In the following, these problems are illustrated through a number of examples.

A frequent problem with agrochemical use is that the workers do not use appropriate equipment to protect themselves from exposure to the toxic chemicals. A study conducted in Bangladesh found that 87% of farmers used little or no protective equipment at all (Dasgupta et al. 2007). Potential reasons for such neglect are many. Protective equipment may simply not be available or it can be unaffordable for poor workers. Wearing heavy clothes and protective equipment in the hot conditions in which sugarcane is habitually grown and harvested not only causes discomfort, but also slows down the work. This is a significant impediment, since for instance in Brazil, the generalisation of mechanical harvesting has also led to an increase in the amount of cane that a manual worker is expected to cut each day (Noronha et al. 2006). Sometimes, such as in the Nicaraguan San Antonio case, the employer does not provide the equipment, or even forces the workers to handle chemicals improperly. Workers may not have washing facilities available to shower after spraying chemicals and for regular washing of clothes; and clothes may, for instance, be washed in sources of drinking water (Brodesse et al. 2006). And finally, lack of awareness among workers about the health risks caused by the agrochemicals is a major reason for negligence. The importance of proper protective equipment is underlined by van Wendel de Joode et al. (1996), who note that sometimes even wearing gloves, overalls, aprons and trousers does not provide adequate protection as the spray solution may get under clothing or soak into it.

Agrochemicals frequently cause harmful impacts, because they are applied at a wrong moment in time, in inappropriate ways, too often or in excessive amounts. A study conducted in Bangladesh revealed that 47% of farmers overused agrochemicals (Dasgupta et al. 2007). Faulty or poor-quality equipment (e.g. leaks and blocked nozzles), low-quality products and adulteration, and the use of “informal” application techniques (bucket and brush) may render products more hazardous or ineffective and contribute to overdosing (Brodesse et al. 2006). Acutely toxic pesticides should not be applied by unprotected workers using hand-held sprayers (Maddy et al. 1990), yet such conditions are frequent in developing countries. Chemicals may be mixed with bare hands, different products combined together, or chemicals may be applied on crops for which they are not intended. Farmers may spray pesticides in a preventive manner, or spray a mixture of different formulas in a single application. The application of such “cocktails” may be conducted when the residual effect of the previous application of the same pesticide is still present. Sprayer pressure nozzles are often left in the same position for different applications, leading to doses greater than appropriate, spraying may be done during high evaporation or on windy days, or the volume of mixture to the unit of area can simply be miscalculated. Other common practices that increase risks include eating, drinking and smoking during application, and spraying against the wind. Watercourses are frequently used for dumping pesticide containers and plastic bottles and to wash spraying equipment. (Guivant 2003)



The relatively common practice among large-scale farmers of spraying the fields from a plane is a double-edged sword from the perspective of the protection of health and the environment. On the one hand, aerial application is usually done by professional sprayers who are able to calculate the correct rates of application, take into account the impact of weather conditions, and thereby allow accurate, targeted spraying. Aerial application also greatly reduces the risk of exposure at one of the most critical phases of pesticide application, namely the mixing and loading of the chemicals. One aerial application can spray vastly more hectares than a team of ground workers, thus considerably reducing the overall exposure.

On the other hand, however, spraying of agrochemicals from planes increases the likelihood that houses near the fields, non-target crops and biodiversity are affected. For example, in the state of Paraná in the south of Brazil, large-scale sugarcane producers have been accused of spraying the fields with herbicides (2,4-D and others), without regard for their impacts on the neighbouring crops (e.g. grapes, coffee, vegetables and fruit trees more generally). Spraying has, indeed, led to significant crop losses for e.g. coffee and fruit farmers in the neighbourhood of cane fields (CPT 2003). Moreover, the accuracy of plane spraying has been called into question and been blamed for precisely contributing to excessive use of agrochemicals (Seedling; Joensen 2008).

The increasingly common practice by sugar mills to outsource the application of pesticides as well as other field operations to contractors constitutes a specific problem, as companies have been suspected of resorting to outsourcing in order to evade their responsibilities towards their employees (Seedling 2008, 10).

A further factor contributing to harmful impacts of agrochemicals is the inadequate handling, stocking and tracing of storage containers. Inadequate product labelling has shown frequently to lead to misuse or overuse of chemicals – chemicals may be for example repackaged in small containers without labels and instructions, and the original containers reused for food and drink storage. Obsolete stocks and used packaging materials are frequently managed without proper care, and facilities for appropriate waste disposal may be lacking. When product labelling exists, the label instructions may be complex and not provided in local languages, whereas poor literacy and lack of understanding of pesticide hazards may further add to the problems. (Brodesse et al. 2006; Dasgupta et al. 2007)

Lack of training and information among farmers handling agrochemicals is a chronic problem, which frequently leads overuse or misuse of agrochemicals in developing countries (e.g. Dung and Dung, 1999; Dung et al., 1999; Huan and Le Van Thiet, 2000, in Dasgupta et al. 2007). Human and financial resources are often not available to provide adequate advice to the users and to enforce law (Brodesse et al. 2006). It has also been found that farmers frequently underestimate the risks associated with chemical use (Dasgupta et al. 2007, 97). A study conducted in the state of São Paulo in the late 1990s found that 57% of the agrochemical users did not receive any type of orientation (Instituto de Economia Agrícola de SP, cited in PNUD 1999). In general terms, a



major problem is that the responsibility for controlling the use of agrochemicals falls upon the farmers, who frequently lack the needed technical orientation and guidance (Andreatta 1998, 354; de Miranda et al. 2007, 11).

A fundamental shortcoming in many developing countries is the lack of appropriate legislation for chemical control and occupational health, as well as the absence of appropriate chemicals approval and registration procedures. Even when such regulatory frameworks are in place, their implementation and enforcement is frequently hampered by serious lack of resources (Brodesse et al. 2006). In both the Nicaraguan and Brazilian cases described above, the problems have been aggravated by turf battles and overlapping mandates between different organisms responsible for regulation and control. Underlying such difficulties are often conflicts of objectives between the authorities in charge of economic production sectors on the one hand, and the health and environmental authorities on the other (CPT 2003).

Price and availability of agrochemicals evidently plays an important role in determining farmers' choices. Especially in the past, governments used to subsidise the price of agricultural inputs, in order to promote economic growth and development of agricultural production. By reducing the cost of agrochemicals to the farmer, these subsidies often have fostered their overuse. Moreover, the acutely toxic pesticides are often easily available, making also their misuse easy – for instance as suicide agents (Brodesse et al. 2006). However, reducing agrochemicals use can make good economic sense, firstly, by reducing the price of inputs, and secondly, by reducing households' health expenditure. In Fiji, it was demonstrated that the farmers who used herbicides spent twice as much on medical care as those who used other forms of weed control (Szmedra 2002).

A major impediment to reducing harmful impacts of agrochemicals is the lack of sufficient information about the hazards among different actors involved (e.g. scientists, analysts, extension workers, decision-makers and farmers). Farmers in developing countries often do not keep written records on the storage, handling, use and disposal of chemicals and empty containers, which makes it difficult to trace down their possible health and environmental impacts (Szmedra 2002). Where chemicals registration frameworks are in place, the post-registration monitoring may nevertheless be lacking (Brodesse et al. 2006). Also, systematic studies of the application of pesticides in developing countries remain scarce and in-depth studies of overuse of agrochemicals are nearly non-existent in the academic literature (Dasgupta et al. 2007). There is a frequent lack of baseline and trend data on chemical residues in food and water as well as on plant and pest resistance to agrochemicals. Strategies to prevent overdosing may also be absent. The local experts and scientists may lack the ability to quickly update their skills and move from a reactive strategy of fighting "bush fires" to a proactive prevention. (Brodesse et al. 2006). To remedy the problem of lacking human and financial resources for monitoring water quality efforts are being made to elaborate modelling methods, which would not require widespread real-time monitoring of water quality (Armas et al. 2007).

Inadequate use of pesticides by individuals does not result merely from ignorance. Virtually all decisions about the use of pesticides, such as those concerning doses, mixtures, brands to buy, etc., are customary, routine decisions, largely influenced by cultural factors and habit, rather than the mere existence or absence of 'correct' knowledge. Field studies among horticulturists in the Southern Brazil demonstrated the significant level of confidence that even farmers with a low education level expressed in their ability to handle chemical inputs (Guivant 2003). Farmers often rejected the advice from expert advisors and extension workers concerning the need for caution in the handling of chemicals, partly because they felt they had been treated as ignorant, but also because they mistrusted advice from experts who did not bear any economic risk for the consequences of their recommendations, and partly because the farmers did not believe there was enough evidence for the existence of risks. If the risks were "real," they argued, there would certainly have been plenty of death cases. If chemicals had not harmed the farmers' health so far, why should they do so in the future? The farmers saw the occasional cases of poisoning and symptoms such as dizziness, vomiting, or headaches simply as something they have to put up with. The poisoning cases would be due to the weakness of the persons affected or mere 'fate'. This denial of the existence of risks and neglect of expert advice can be seen as an adaptive strategy, which allows the farmers to avoid anxiety and doubt, which would make it more difficult for them to carry on with their work. In sum, Guivant (2003) describes the key problem as one of a cognitive dependence by farmers on the belief in pesticides' effectiveness, combined with distrust in the sources of information.



## Voluntary efforts: international codes of conduct and certification

Perhaps the most significant among the voluntary guidelines in the area of pesticides is the International Code of Conduct on the Distribution and Use of Pesticides. The Code was first adopted in 1985 by the FAO Conference, and was subsequently revised in 2002. The Code establishes “voluntary standards of conduct for all public and private entities engaged in or associated with the distribution and use of pesticides, particularly where there is inadequate or no national legislation to regulate pesticides.” <http://www.fao.org/docrep/005/Y4544E/y4544e00.HTM> It places particular attention to training as a means of promoting good practices of pesticide application, thereby minimising the potential harmful health and environmental impacts. It emphasises collaborative efforts by governments, industry, and civil society organisations and provides recommendations to all these parties. The Code is based on a life-cycle approach, seeking to cover the entire chain of pesticide production and use, i.e. the development, regulation, production, management, packaging, labelling, distribution, handling, application, use, control, post-registration activities and disposal, trade and regulation of pesticides. The Code seeks to actively promote Integrated Pest Management (IPM), the exchange of information and the implementation of the relevant international agreements.

Several voluntary, private sector and multistakeholder projects and initiatives are specifically targeted at promoting more environmentally and socially sustainable sugarcane cultivation. A few of the most significant ones include the following:

Among the most influential industry initiatives are the Code of Practice for Sustainable Cane Growing in Queensland, and the South African Sugar Association’s Manual of standards and guidelines for conservation and environmental management in the sugar industry (SASA, 2002).

In Brazil, a multistakeholder team developed in 2002 the ‘Principles and General Criteria for Social and Environmental Certification Imaflora/SAN of the Sugarcane Culture’, stipulating practically applicable environmental and socio-economic standards and criteria for sugarcane cultivation. However, the code has not been applied yet in practice, mainly because of lack of interest from the industry and politicians. (Smeets et al. 2008, 799)

The Fairtrade Labelling Organisation (FLO) has developed standards for socially and environmentally responsible production and trade, including specific criteria for sugar made from sugarcane (Smeets et al. 2008, 799).

The Ethanol and Sugar Impact Analysis (ESIA) is a multistakeholder process seeking to develop standards and criteria, so as to guarantee “that sugar/ethanol companies respect social, communal and environmental standards”, in the spirit of corporate social responsibility. The project draws on the work done within the Better Sugarcane Initiative, the Roundtable of Sustainable Biofuels, and the UK Renewable Transport Fuel Obligation (Smeets et al. 2008, 799). <http://www.esiaconsulting.com/>

The Better Sugarcane Initiative (BSI), promoted by the WWF is a multistakeholder initiative to improve sugarcane's environmental and social performance (Smeets et al. 2008, 799). The BSI general principles were agreed in 2007, followed in the subsequent year by the adoption of around 60 essential criteria and indicators that cover all relevant areas of social and environmental concern. The BSI establishes targets, but does not prescribe how farmers should reach these target values. The implementation is ensured through locally developed better management practices (BMPs). (Willers 2009, 17) For instance in Pakistan, the BMPs have led to the near elimination of pesticide use in sugarcane production, while the integrated pest management systems implemented in Central America have allowed up to 25% reductions in pesticide application (May and Ogorzalek 2009, 15).

### Problems and possibilities of international certification schemes

Unlike for food crops, the public concern for chemical residues in sugar has so far had a negligible impact, if any, in stimulating reduced use of agrochemicals in sugarcane cultivation. Moreover, in ethanol production, such residues are no concern at all. Efforts to develop sustainability certification systems and to promote Corporate Social Responsibility are therefore particularly relevant in attempts towards more judicious use of agrochemicals.

Numerous such schemes are currently in development, at international level, initiated by various public and private sector organisations (table 2). Most schemes involve criteria relating to the correct use of agrochemicals, and can therefore in principle operate as a powerful tool in favour of better use of agrochemicals.

**Table 2. A selection of international initiatives relevant for biofuel sustainability certification**

Scheme	Initiator/participants
Roundtable on Sustainable Biofuel	École Polytechnique Fédérale de Lausanne
International Bioenergy Platform - IBEP	FAO
IEA Bioenergy Tasks 30, 31 and 40	IEA
Global Bioenergy Partnership	G8 +5 / UNEP
European Green Electricity Network – EUGENE	Network of researchers, consumer and environmental NGOs
Roundtable on Sustainable Palm Oil	Palm oil supply chain stakeholders
Roundtable on Sustainable Soy	Soy supply chain stakeholders
Better Sugarcane Initiative	Sugarcane supply chain stakeholders
IDB Biofuels Sustainability Scorecard	Inter-American Development Bank
International Sustainability & Carbon Certification	German government
Forest Stewardship Council – FSC	Forest sector stakeholders

In the state of São Paulo, a system of socio-environmental certification of ethanol fuel has been implemented. While this system only covers sugarcane cultivated for ethanol – not sugar – it can nevertheless make a significant contribution towards better agrochemical use in the entire sugarcane sector. In order to obtain a certificate, a producer must comply with a number of criteria, including worker education and training, storage of agrochemicals, proper use of protective equipment, etc. (Azevedo 2009)

One major problem with certification schemes is, however, the danger that certification might become an obstacle to market access by small producers, who do not have the resources required to put in place the required systems of monitoring, reporting and quality control. This underlines the importance of multistakeholder processes, in which the small-scale producers as well as field workers are fully represented. However, to ensure that the multi-stakeholder processes actually deliver what they promise – credible and legitimate certification schemes, which, after all, are vital also for the survival of the sugar, ethanol and agrochemical industries – more attention will be needed to the structural reasons that prevent participation by different stakeholders on an equal footing. So far not only local civil society organisations, but also small-scale southern hemisphere crop producers have been underrepresented at best and absent at worst from negotiations on major certification schemes. Remedying the situation requires more than merely ‘opening the doors’ to all participants; active measures are necessary to ensure that the weaker parties are able to fully contribute to the process. Even within international forums considered as legitimate, such as the International Organization for Standardization (ISO), the developing countries are disadvantaged by the sheer lack of money, human resources and technical capacity. Assistance from organisations such as UNCTAD to developing country governments helps redress inequality between countries, but does not ensure that all groups of society get represented.

## Promoting better use of agrochemicals through Integrated Pest Management (IPM)

Integrated pest management is frequently recommended by various international initiatives to minimise the need for chemical pest and weed control. The International Code of Conduct on the Distribution and Use of Pesticides has defined IPM as

“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 minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agroecosystems and encourages natural pest control mechanisms.” (FAO 2003, 6)

While it is important to reduce the hazards that agrochemical use poses to the workers and the environment, it is at least equally necessary to take preventive measures and develop alternative pest and weed control strategies. Identification of resistant cultivars, adherence to optimum planting times and biological control methods that rely on the natural enemies of pests can significantly reduce the need for chemical control. Promising IPM strategies have been developed in many countries and regions, including the South Pacific, Brazil, India and South Africa. Biological control strategies have been applied for decades, to varying extent and degrees of success, in different parts of the world (see e.g. Cheesman 2005).

In Guyana, chemical pest control has been all but abandoned, thanks to biological control methods (Cheesman 2005, 46). In the Brazilian sugarcane sector alternative measures have been developed for a long time already. Examples include the use of the fungus *Metharizium* to limit the populations of the major sugarcane pest, the spittlebug (*Mahanarva fimbriolata*). The cost per hectare of this method is as much as ten times lower than that of chemical insecticides. Promising experiments have demonstrated the efficiency of small worms called nematodes in controlling spittlebug in both field and laboratory conditions, but this method is still far more expensive than using the *Metharizium* (Ereno 2002; Leite et al. 2005; Vian et al. 2006, 14). Another successful example of biological pest control intensively used in Brazil for several years already is the releases of parasitoids such as *Trichogramma* spp. and *Cotesia flavipes* to control the sugarcane stemborer *Diatraea saccharalis* (Bothelo et al., 1999). Many other producing countries such as India, Indonesia, Thailand, Reunion and Mauritius encourage their small scale farmers to use biological control against the considerable damage that moth borers (*Chilo sacchariphagus*, *Scirpophaga excerptalis*) can cause to sugarcane plantations (Goebel, 1999).

An important prerequisite for introducing biological control is the abandonment of the practice of burning sugarcane fields prior to harvesting. Burning is still common, for instance in some parts of Brazil, especially on steep slopes, where harvesting cannot be mechanised. Burning of sugarcane fields is virtually unavoidable, if sugarcane is to be harvested manually, because it removes the sharp leaves of the plant, which would otherwise cause injuries to the workers. However, burning also has a number of significant downsides, including local air pollution, the destruction of soil organic matter, and the acceleration of soil erosion. Most important of the harmful impacts for



the purposes of the present paper is that while burning contributes to pest control in the short term, it kills not only the pests but also their predators, thereby leaving chemical pest control as the only alternative (Goebel 2001; Vian et al. 2005, 16-17). Burning also works against the objective of building up levels of organic matter in the soil, which could reduce the need for pesticides, fertilisers, and water [http://www.panda.org/what\\_we\\_do/footprint/agriculture/sugarcane/better\\_management\\_practices/](http://www.panda.org/what_we_do/footprint/agriculture/sugarcane/better_management_practices/)

Measures of integrated management specifically adapted for small-scale sugarcane cultivation include:

- Intercropping of sugarcane with other crops (e.g. wheat, potato, cowpea, French bean, chickpea, water melon, etc.) In addition to allowing more effective utilisation of land, in India this practice has been found to reduce the weed growth up to 60% and provide extra income to farmers. (ICRISAT-WWF 2009)
- Trash mulching following the harvest significantly reduces weed growth, but also provides needed moisture (ICRISAT-WWF 2009)
- Mechanical weeding can be viable, especially in small-scale farming and when labour resources are abundant
- The use of soil conservation agents (e.g. Curasol AH) can reduce herbicide mobilisation in the soil and thereby reduce the harmful environmental effects of herbicides use (Cheesman 2005).

The WWF provides practical advice on better management practices in sugarcane cultivation, including the specific recommendation to apply Integrated Pest Management. In cases when agrochemical use cannot be completely avoided, the WWF advises the farmers to:

- Use economic thresholds to determine whether pesticides bring added value and are therefore necessary
- Choose pesticides that are the least toxic
- Choose the most targeted ones instead of broad-spectrum pesticides to avoid build-up of pest resistance
- Not use pesticides in a preventive (prophylactic) manner
- Respect the maximum dosage recommendations
- Not apply pesticides on windy days and during the rainy season (or just prior to strong forecasted rains)
- Plant filter strips of vegetation around fields to control erosion, but also to reduce dissolved pesticide flows into watercourses

### Organic sugarcane cultivation

Beyond IPM, a step further towards totally chemical-free sugarcane cultivation is organic farming. As the largest producer of organic cane and sugar in the world, the São Francisco mill in the state of São Paulo has demonstrated that organic cane cultivation can be viable at a large-scale. It currently produces some 80 000 tons of organic sugar, of which one-fourth is exported to a total of 51 countries. <http://aprendiz.uol.com.br/content/swokideueb.mmp>



Status report on sugar cane  
agrochemicals management

ETHICAL-SUGAR

## GMOs: friend or foe?

Efforts to develop transgenic sugarcane are underway in a number of countries (e.g. Australia, Argentina, Brazil, Cuba, Egypt, India, Indonesia, Mauritius, Myanmar, South Africa, USA, and Venezuela) (<http://www.bettersugarcane.org/assetsgeneral/istransgenicsugarcaneabmp.pdf>). One of the main aims of such efforts is the development of herbicide-resistant cane varieties. However, this raises particularly tricky questions concerning agrochemical use. Herbicide resistant soy varieties have been cultivated for some time already, and the development of herbicide-resistant sugarcane is underway. For instance in Brazil, genetic improvement of sugarcane varieties has been widely applied for some time already, and continues to be one of the main means to improve pest and herbicide resistance and thereby allow further reduction of agrochemicals (Veiga Filho 2008, 7). These efforts have included the Cane Genome project, completed in 2003, involved the sequencing of 40 000 cane genes related to disease resistance, stress response, nutrient metabolism, etc. The Sucarcane Technology Centre (CTC) has also developed transgenic cane varieties. (Smeets et al. 2008, 789) CanaVialis, the world's largest private sector sugar cane breeding company, and a biotechnology company Allelyx entered in a partnership with Monsanto to develop genetically modified cane varieties resistant to glyphosate. Monsanto bought the two companies at the end of 2008, and became hence the world's largest sugarcane breeding company. It already has regulatory approval for exporting its glyphosate resistant (Roundup Ready) sugar beet to the EU and Japan, and similar regulatory approvals are possible for 'Roundup Ready' sugarcane. (Seedling 2009)

However, the public opinion in Brazil remains divided on the issue of GMOs. The development of herbicide resistant cane varieties is feared to increase the domination of sugarcane sector by large, vertically integrated conglomerates, thereby excluding small, independent farmers. A concern more specifically related to the theme of this paper is that herbicide-resistant sugarcane grown in large plantations may incite farmers to overuse herbicides, as seems to have happened with the introduction of herbicide-resistant soy varieties (Joensen 2007).

Finally, the high amounts of herbicide applied may lead to the development of herbicide-resistant weeds. Such weeds have not yet been found in sugarcane cultivation, but the rapid increase of herbicide resistance in crops such as soybeans, cotton and corn suggests that this situation may change (FoE & CFS 2008; Smeets et al. 2008, 785; Center for Food Safety 2008). The industry's suggestion to combating herbicide-resistant weeds – to genetically engineer a new generation of plants to resist even more toxic and persistent weed killers such as 2,4-D and dicamba (Robinson, E. 2008) – might lead to a never-ending 'arms race' between cane breeders who develop ever-more herbicide-resistant varieties, and the weeds that respond by developing their own herbicide resistance.

## Conclusions: who should do what?

The increase in sugarcane yields in both developed and developing countries has taken place partly thanks to the ready availability of chemical inputs – in the case of sugarcane particularly chemical herbicides. At the same time, chemical use has significantly increased the burden that sugarcane cultivation poses on workers' health and on the environment. While organic sugarcane farming has been implemented at places, totally chemical-free sugarcane cultivation on a large scale is still but a long-term objective. However, implementing alternative methods will require much more than merely removing the use of chemical inputs – for instance, for sugarcane cultivation in Fiji, it has been estimated that without herbicides, production would decline by 20-50% (Szmedra 2002). The minimisation of the harmful impacts of agrochemicals use in sugarcane cultivation will require careful planning and collaboration between different actors in the field.

The International Code of Conduct on the Distribution and Use of Pesticides contains a raft of recommendations concerning ways to minimise the harmful impacts of the use of agrochemicals. However, implementing these recommendations in practice remains a major challenge. As this paper has sought to demonstrate, the health and environmental problems associated with agrochemical use often stem either from the absence of pesticide legislation and regulation framework, or from the failures in implementing and controlling such regulation. Poor implementation and enforcement, in turn, often result from weak institutional capacities (e.g. lack of qualified personnel, lack of laboratories for risk assessment) or insufficient financial resources.

In particular, advice, training and education of people directly involved in agrochemical use are crucial in ensuring the implementation of good practices. The importance of collaborative approaches is generally recognised as a prerequisite for successful information campaigns. The participation of farmers in designing for instance policies of integrated pest management is all the more important given the complex interplay between the extension workers and farm advisors on the one hand, and the workers in the fields, on the other. Lack of information among farmers is often, but not always the main cause of problems. As the studies in Brazil concerning farmers attitudes to chemicals and expert advice on pesticide hazards demonstrate, a "top-down" strategy of provision of expert information is unlikely to yield the expected results, as it erroneously assumes that all obstacles for the implementation of good management practices stem from the ignorance of farmers. A more nuanced view and a more intelligent approach would recognise the importance of cultural factors and the power and conflicts that are omnipresent in the relationship between farmers and experts. Guivant (2003) sites the example of the prevailing "masculine values" among farmers, which effectively prevent these from taking seriously the warnings about the potential cancer risks from inappropriate use of agrochemicals. Instead, Guivant suggests that providing information about the effects of pesticides on reproduction and male fertility can be more efficient strategy.

While not specifically related to sugarcane, the recommendations of the International Code of Conduct on the Distribution and Use of Pesticides provides a useful benchmark against which to assess the measures aimed at enhancing better use of agrochemicals in sugarcane cultivation. Table 3 summarises the recommendations and the respective roles of the different actors in the area.

**Table 3. Summary of the recommendations to key stakeholders on better use of agrochemicals (modified from International Code of Conduct on the Distribution and Use of Pesticides).**

### **Governments**

Risk assessments, chemicals registration, control and information

- Establish a pesticide registration and control system
- review the pesticides marketed in the country
- conduct risk assessments under the actual conditions in the field and based on realistic exposure data
- provide reliable data and statistics on health aspects of pesticides and pesticide poisoning incidents
- ensure that pesticides are, in sales outlets, physically segregated from other merchandise to prevent contamination and/or mistaken identity

Choice of products; promotion of alternative management practices

- develop national IPM policies in order to reduce chemical control
- promote the participation of farmers (including women's groups), extension agents and on-farm researchers in the development of IPM policies
- promote the use of target-specific chemicals

Health surveillance, monitoring and advice

- introduce health surveillance programmes, including monitoring of poisoning cases
- provide guidance and instructions to health workers, physicians and hospital staff on poisoning cases
- establish poisoning information and control centres
- programmes for monitoring pesticide residues in food and the environment

Farmers' extension services

- provide extension and advisory services and farmers' organisations with adequate information about IPM strategies and available pesticides

Assistance to developing countries

- support for capacity building in developing countries, in areas such as
- pesticide risk assessment
- registration and monitoring
- post-registration surveillance and monitoring

### **Industry**

Choice of products; promotion of alternative management practices

- make available less hazardous products
- avoid products whose application requires that the workers wear equipment that is expensive or uncomfortable especially in tropical conditions
- introduce products in ready-to-use packages
- use returnable and refillable containers when recycling and reuse facilities are available
- use containers that are not attractive to reuse, or attractive to and easily opened by children
- use clear and concise labelling; provide information and guidance in a language understandable to the user

#### User training, advice and education

- provide technical support, full product stewardship to field level, including advice on disposal
- provide to the relevant authorities training and assistance in methods for the analysis of any active ingredients or formulations contained in the products manufactured by the industry

#### Risk assessments, chemicals registration, control and information

- maintain a process of continuous monitoring and follow-up of the use of chemicals
- make available for the relevant government authorities copies or summaries of the original reports of pesticide effectiveness and hazard tests in all countries where the pesticide is to be offered for sale
- co-operate in periodic reassessment of pesticides
- ensure that pesticides manufactured for export are subject to the same quality requirements and standards as those applied to comparable domestic products

#### Health surveillance, monitoring and advice

- provide poison-control centres and medical staff with information on pesticide hazards

#### **International organisations**

- assistance in technical capacity building, together with governments

Monitoring and observance of the Code should be undertaken through a collaborative effort by governments, industry, international organisations and NGOs



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# Example of a civil society campaign : Nicaragua Case



**Example of a civil society campaign linked with agrochemicals and sugarcane**

**The sugarcane workers are in Managua**

ANAIIRC mobilizes to demand damages from the Pellas Group

A total of 2,202 people have died between March 14, 2005 and March 5, 2009. Forty-six people die every month as a result of CRF alone.

March 11, 2009 – Managua - Giorgio Trucchi – RE- UITA



They set out from Chichigalpa, in western Nicaragua, at 4 a.m. on March 9, so they would arrive early at Managua. They set up camp near the Cathedral, with their hammocks, their things and the food they had brought with them. The campsite is located in the center of the city, some 500 meters from the Pellas Building, where the powerful economic group concentrates all of its activities in the Nicaraguan capital. The campers are the former sugarcane workers grouped in the Nicaraguan Association of People Affected by Chronic Renal Failure (ANAIIRC), an IUF affiliate.

They decided to march to the capital to demand that they be compensated for the serious illness they developed while working at Ingenio San Antonio. The members of ANAIIRC have been denouncing the responsibility of the Pellas Group -which includes the company Nicaragua Sugar Estates Ltd., owner of Ingenio San Antonio- for years now, blaming it for the indiscriminate use of agrotoxic chemicals in the sugarcane plantations and the ensuing pollution such chemicals have caused in the area's aquifers.

According to ANAIIRC statistics, 3,209 people have died in the last few years in the departments of León and Chinandega, and there are over 4,000 more that have been affected. It is a real epidemic that has left thousands of widows and orphans. Which explains why many of the 200 people that have marched to the capital are widows, who are asking the company to respond for the death of their husbands.

In a press release sent to the media last week, the former workers affected by CRF declared that Law No. 456 (the Act for the Addition of Occupational Risks and Illnesses) classifies CRF as a professional illness and includes it in the Code of Labor.

The number of people who have died is calculated based on the deaths reported in the Municipality of Chichigalpa, and the cases that are reported to ANAIIRC by people from other municipalities. A total of 2,202 people have died between March 14, 2005 and March 5, 2009.

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Forty-six people die every month as a result of CRF alone. This situation, the press release says, must bring the country's competent authorities to declare a health emergency, particularly in the area where sugarcane is planted.

The situation is even more serious if we consider that, according to the people affected, when someone dies of CRF, the health system records the cause of death as heart attack. The aim of this is to hide this professional illness, thus "covering up for" the employer who should respond for putting their workers' health at risk and endangering their lives," the release says.

For this reason, ANAIRC has sent yet another letter to the company -the tenth letter in just a few years- asking Mr. Carlos Pellas, president of the Group, to sit down to talk with the victims and open up a negotiation process.

"Over the past few years we've sent several letters to Mr. Carlos Pellas, asking him to listen to us and give us a response, but he has refused to even acknowledge our request," the vice-president of ANAIRC, Gustavo Martínez, said to SIREL.

"We want to be compensated by the Pellas Group for the damages it has caused us. Right now, everyone is resting, because the trip has been very tiring, but in the next few days we will begin a series of mobilizations to protest in front of the Pellas Building so that they will hear us."

For Julio César Paz, another member of ANAIRC, this march to Managua was something that could not be put off any longer. "We've seen too many people die in Chichigalpa, and as we have had no reaction from the owners of Ingenio San Antonio, we had no choice but to come here to demand compensation."

Verónica Flores, one of the widows in ANAIRC, says that what she's had to go through since her husband died from CRF has been extremely tough. "Our struggle, as widows, is for a just cause. My husband worked for almost 25 years at Ingenio San Antonio, where he got sick. It's a sad illness, because it slowly wears you down, until you're left without any strength, without any possibility of working. He spent the last six years of his life sick, but the final two years were the worst. He suffered so much, until finally he passed away in September 11, 2008.

The illness and death of our husbands -Flores continues- has forced us widows to take over the responsibility of supporting our families, and it's very hard, because we have nowhere to turn to earn enough to survive. In my case, I receive a widow's pension of 100 dollars a month, but that doesn't even cover minor expenses. And that's why we're here.

Our husbands died because of their work at Ingenio San Antonio and it's fair that we should be compensated. We're not going to budge from here until we get an answer. I ask people and organizations in the country and around the world to support us, because we're fighting for something that is just, and it is important that everyone is aware of what happened in the Chichigalpa sugarcane plantations and all we've been through," Flores concluded firmly.

In these first hours in Managua, ANAIRC distributed letters to the Health, Environmental and Natural Resources Commissions in Parliament, and the Labor and Social Security Commission, asking for their support. It also sought out medical support from the Nicaraguan chapter of the Red Cross, to guarantee immediate health care in the event the situation of some of the sick people at the camp worsens.

Various organizations have joined in to support the struggle, and the IUF will continue to follow the mobilization closely to report on any new developments.

[www.rel-uita.org/agricultura/agrotoxicos/irc](http://www.rel-uita.org/agricultura/agrotoxicos/irc)

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ETHICAL-SUGAR



[http://en.wikipedia.org/wiki/Flor\\_de\\_Caña](http://en.wikipedia.org/wiki/Flor_de_Ca%C3%B1a)

## Criticism

Some Nicaraguan consumer groups have started a boycott against Flor de Caña rum and other products of Grupo Pellas, in support to the protests of former sugar cane workers of Grupo Pellas, who demand compensation for the chronic kidney disease they claim was caused by the chemicals used in Grupo Pellas's plantations.[14][15][16][17][18][19][20][21][22][23][24][25]

Grupo Pellas, Compañía Licorera de Nicaragua (producer of Flor de Caña Rum), and Nicaragua Sugar Estates Limited (owner of Ingenio San Antonio), deny these accusations and declare that each of their production practices are in full compliance with the provisions stipulated under all applicable labor and environmental Nicaraguan laws, as well as meet the strictest international quality and production standards.[26][27][28][29][30][31][32][33][34][35][36][37]

1. ^ [1]
2. ^ Grupo de Boicot a la Flor de Caña
3. ^ Videos sobre la responsabilidad de la Nicaragua Sugar Estates
4. ^ Video denuncia cañeros
5. ^ Video denuncia cañeros frente Edificio Pellas
6. ^ Cañeros 4 meses de protesta
7. ^ La verdad sobre la lucha de la ANAIRC
8. ^ FNT denuncia acuerdo entre Grupo Pellas y sindicatos blancos
9. ^ FNT desconoce firma de acuerdos
10. ^ The truth on Pellas Group's shameful insensitivity
11. ^ Pellas Group displays a shameful insensitivity
12. ^ Nicaragua Network Boycott Flor de Caña in Support of Sugar Workers!
13. ^ La Verdad sobre Nicaragua Sugar y la IRC - The truth about Nicaragua Sugar and CKD
14. ^ Videos sobre Grupo Pellas - Pellas Group Videos
15. ^ Signing of important agreement, rejecting the discreditation, slander and boycott campaign initiated by ANAIRC
16. ^ Trade Unions Support NSEL, Compañía Licorera and Grupo Pellas against the baseless CRI campaign launched by ANAIRC and UITA
17. ^ Trade Unions Give Their Support to Grupo Pellas
18. ^ BOYCOTT FLOR DE CAÑA: WORKERS PROTEST ANAIRC'S CKF CAMPAIGN AGAINST GRUPO PELLAS AND NICARAGUA SUGAR (IRC, CKD)
19. ^ GRUPO PELLAS, NICARAGUA: UNIONS PROTEST AGAINST ANAIRC UNFOUNDED CKD CAMPAIGN AND FLOR DE CAÑA BOYCOTT (IRC, CKF)
20. ^ BOYCOTT TO FLOR DE CAÑA: EXTENSIVE REJECTION TO ANAIRC'S UNFOUNDED CKD (IRC, CKF) CAMPAING AGAINST GRUPO PELLAS
21. ^ LA VERDAD SOBRE LA RESPONSABILIDAD DE GRUPO PELLAS Y NICARAGUA SUGAR y LA IRC
22. ^ GRUPO PELLAS Y SUGAR ESTATES RESPONSABLES DE LA IRC
23. ^ TODO LO QUE DEBEN SABER SOBRE LA RESPONSABILIDAD DE NICARAGUA SUGAR-GRUPO PELLAS y LA IRC
24. ^ LEY 456 de Nicaragua afirma que la IRC es una enfermedad profesional relacionada con la industria azucarera

**Status report on sugar cane  
agrochemicals management**

**ETHICAL-SUGAR**



## Better sugarcane initiative : Biodiversity and Systems standard

### Principle 4 -Actively manage biodiversity and ecosystem services

Who and What is BSI?

BSI is a global multi-stakeholder non-profit initiative dedicated to reducing the environmental and social impacts of sugar cane production.

It aims to achieve this with a Standard that measures these impacts accurately, and with the development of a system to certify that sustainable practices are being adhered to.

Why BSI Exists

- Responsible consumers and producers today expect that all agricultural and industrial enterprises need to operate not just economically but also in a way that promotes social and environmental factors.
- This emphasis on sustainability is now a commonplace, especially in the sugar cane sector where energy use, production efficiency, elimination of waste and the effect on global climate change are all being closely monitored.
- Large corporate consumers of sugar cane products, especially sugar and ethanol, also need to be certain that sugarcane and other ingredients in their products are being produced by means of sustainable practices. In fact many people see sustainable development as the most important challenge facing the planet today.

[www.bettersugarcane.com](http://www.bettersugarcane.com)



Status report on sugar cane  
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ETHICAL-SUGAR

#### 4.1 Criterion - To assess impacts of sugarcane enterprises on biodiversity and ecosystems services.

Indicator	Processing & Milling	Agriculture	Verifier	Standard	Notes
Aquatic oxygen demand per unit mass product	●		kg/t	1 kg COD or 0.5 kg BOD5	Oxygen demand by calculation of quantity and analysis of runoff. Environmental burden can be expressed in terms of either COD or BOD5, depending on routine measurements available.
Percent of areas defined internationally or nationally as legally protected or classified as High Conservation Value areas (interpreted nationally and officially as described in Appendix 1) planted to sugarcane after the cut off date of 1 January 2008.		●	%	0	To prevent expansion or new sugarcane development into areas of critical biodiversity (including HCVA categories 1-4). National definitions of HCVA to take precedence over international where both exist. In the absence of national HCVA maps or data base, credible documentary evidence required that no HCVA converted after 1 Jan 2008. Also includes soils with a large risk of significant soil stored carbon such as peat lands, mangroves, wetlands and certain grasslands.
Existence and implementation of an environmental management plan (EMP) taking into account endangered species, habitats and ecosystems as well as reference to ecosystem services and alien invader plant and animal control, as described in Appendix 4. Coverage of issues required in Appendix 4.		●	%	90	To protect any existing riparian areas, wetlands or other significantly affected natural habitats in a satisfactory state, to provide habitat corridors and to conserve any rare, threatened or endangered species. The EMP should focus on risks, management responses, and implementation.
Use of co-products does not affect traditional uses (e.g. fodder, natural fertilizer, local fuel) or affect the soil nutrient balance or soil organic matter	●	●	Yes/No	Yes	Use of agricultural co-products as inputs must not jeopardize local uses or adversely affect soil quality
Soil and leaf nutrient status		●	%	>80	% fields fertilized based on soil or leaf analysis
Nitrogen and phosphorus fertilizer (calculated as phosphate equivalent) applied per hectare per year		●	kg/ha/y	<120	Environmental burden is kg phosphate equivalent as defined in Appendix 1 - measuring risk (i.e. amounts applied) rather than level in downstream water. Quantities of nitrogen and phosphorus fertilizer applied calculated as the phosphate equivalent as a measure of potential effects on eutrophication per hectare per year. To minimise losses from over application and consequent ground water or downstream contamination.
Herbicides and pesticides applied per hectare per year		●	kg active ingredient/ha/y	5	To minimise air, soil and water contamination. Quantities of pesticide (including herbicides, insecticides, fungicides, nematicides, ripeners) applied calculated as a measure of potential toxic effects on the environment. Also note the requirement to use only products registered for use and at registered rates and to comply with the Stockholm convention on persistent organic pollutants and requirements in relation to agrochemicals rated as 1a, 1b or 2 under World Health Organisation (WHO) classification.

4.2 Criterion - To implement measures to mitigate adverse impacts where identified

Indicator	Processing & Milling	Agriculture	Verifier	Standard	Notes
Documented plan and implementation of mitigation measures	●	●	Yes/No	Yes	Existence of a list of identified adverse impacts such as smoke, fallout from fires, water pollution downstream, drift from agrochemical spraying and noise. Existence of a mitigation plan, and verification of the implementation of mitigation measures, including consultation with affected stakeholders. Programs with objectives developed at the sectorial level can be considered.

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*For a sugar which respects human beings and its environment*