Reducing hazardous pesticide practice in coffee supply chains.

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Food & Fairness Case Study

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Executive Summary

This case study looks at the approaches of different private, voluntary standards in coffee supply chains on controlling the use of hazardous pesticides and moving to safer pest management. It draws some conclusions from the different schemes and highlights issues for private and public sector stakeholders.

While coffee production provides a livelihood for over 25 million people in developing countries, pesticide use in coffee farms large and small poses hazards for the health of farm families and workers and wildlife and contaminates water, soil and air (section 1). Several studies document adverse health effects among coffee farm workers and smallholders, including dizziness and headache, eye irritation or skin irritation, respiratory and digestive problems. Acute poisonings may also occur-over 150 people were poisoned in one coffee-growing district in Colombia in 2007, through exposure to the insecticide endosulfan.

Unlike fresh fruit and vegetable supply chains, where pesticide residue concerns drive efforts to improve food safety, residues in coffee retail products are unusual. Efforts to change hazardous pesticide practices in coffee production therefore need to address production conditions beyond food safety. Numerous private standards schemes have introduced different environmental, social and economic requirements in coffee production, as certified products with a consumer label, or as farm assurance programmes at business level. Studies have assessed the impact of these schemes on smallholder livelihoods, environmental sustainability or corporate social responsibility but have not examined pesticide aspects in detail. This case study focuses on pesticide use and handling, hazard reduction and pest management in six major schemes in the coffee and private standards worlds (described in section 2): the Sustainable Agriculture Network standard (SAS), for Rainforest Alliance; Utz Certified; FLO Fair Trade; EurepGAP/GlobalGAP; Common Code for the Coffee Community (4C); and Starbucks' C.A.F.É. Practices. The 4C Code is a baseline entry scheme while the others operate at higher levels of practice requirements and sustainability claims.

Section 3 details requirements or recommendations on pesticides prohibited or restricted in their supply chains and reducing toxicity and/or volumes used. Schemes include different prohibitions on specific pesticides, based on international conventions, official hazard classifications, PAN's Dirty Dozen or banned lists from the EU and US. Only FLO and C.A.F.É. Practices prohibit the most acutely toxic (WHO Class Ia and Ib) pesticides, although they permit some exemptions. All schemes except GlobalGAP include some requirements or progress to use less toxic pesticides. Rainforest Alliance SAS and C.A.F.É. Practices require farms to record and assess the reduction in toxic pesticide use.

Only the 4C Code considers chronic health damage from pesticides in its hazard assessment, although reducing pesticides linked to cancer and hormone system disruption is part of its longer-term progress. Generally scheme requirements on reducing pesticide reliance are framed as aims, without concrete targets or timelines. It is therefore hard to assess how progress could be monitored and compared.

Requirements on pesticide handling, health and environmental protection and pest management strategies are compared in section 4. Rainforest Alliance SAS, Utz, FLO and GlobalGAP all require health and safety policies to be in place. All schemes except 4C require training for those handling pesticides, with Rainforest Alliance SAS having the most detailed requirements. All schemes except 4C have broadly similar requirements on first aid, obligatory provision of personal protective equipment and communicating hazard information although they differ on health protection. Rainforest Alliance SAS, FLO and C.A.F.É. Practices prohibit minors under 18 or pregnant and nursing women from applying agrochemicals and limit the number of hours those applying pesticides may do such work. FLO and Rainforest Alliance SAS operate the most detailed requirements on health protection and both require regular medical checks. Only Rainforest Alliance SAS includes communicating spray warnings for neighbouring communities. GlobalGAP puts the most emphasis on consumer food safety protection, with the most detailed requirements on respecting pre-harvest intervals and requires farmers to monitor residues in their crops.

All schemes with detailed requirements stipulate obligatory inventories of pesticide stocks and application records. Utz and FLO also stipulate that these documents include specific poisoning symptoms for each pesticide. Most schemes require some form of justification of pesticide applications but it is not clear whether these amount to more than just naming the target pest, disease or weed, or a detailed explanation of why chemical control was needed for each application. Storage facility requirements exist for all schemes except 4C, with Utz, GlobalGAP and Rainforest Alliance SAS having the most detailed specifications for store construction, facilities and location. Re-use of empty pesticide containers to store food and drinking water is a major hazard and common practice among untrained smallholders and sometimes on large farms too. All schemes except 4C require that such re-use is prevented, with four schemes stipulating that empty containers are triple-rinsed. Utz and C.A.F.E. Practices also require that containers are punctured so they cannot be re-used for household purposes.

All schemes, except 4C, have obligatory requirements to prevent pesticides being applied close to water bodies, although buffer zone distances vary considerably. 4C's principle on conserving water quality may introduce specific requirements to be implemented medium-term. FLO and Rainforest Alliance SAS have the most detailed buffer zone requirements, which cover also drinking water sources, forest areas and public roads. C.A.F.É. Practices restricts herbicide use, in order to reduce soil erosion, while FLO prohibits aerial spraying of insecticides and herbicides.

All schemes promote IPM and/or Integrated Crop Management but vary in the priority and detail. None of them include IPM as a critical control point. Rainforest Alliance SAS and C.A.F.É. Practices both require written IPM plans and field monitoring to assess the need for control interventions. C.A.F.É. Practices awards points for using trapping methods for coffee berry borer, one of the key pests affecting coffee quality in Latin America. GlobalGAP only introduced requirements on IPM in 2008.

From the schemes' published information it is hard to judge how they perform in practice and what actual benefits they deliver, a major criticism of standards based on field practice requirements, rather than impact targets. Although auditing gathers a huge amount of data on compliance with each scheme's criteria, almost none of this is available for public interest groups, government decision makers or consumers to compare the achievements, if any, in facilitating real change. There is a major data gap on how far standards schemes reduce pesticide-related ill health in farming communities or environmental damage.

Rainforest Alliance SAS, FLO and C.A.F.É. Practices are the most ambitious standards in prohibiting and phasing out the most acutely toxic pesticides. Despite having the greatest number of control points on pesticide-related aspects, GlobalGAP makes negligible effort to remove hazardous compounds, while Utz goes further by including some prohibitions. 4C deserves recognition for including some prohibitions and medium term phase outs despite being a 'minimum baseline standard' scheme.

Farmers need to analyse practices and share experiences in order to implement effective IPM. This requires investment in training and few of the schemes explain if, or how, such training is provided. 4C demonstrates the clearest commitment to training and advice for improvement, through its Support Platform services. Without such support, schemes may struggle to reduce overall reliance on pesticides or to remove certain problematic ones from their supply chains, if farmers are not confident in how to phase them out without risking crop loss or quality. Standards schemes could play a valuable role by joining together to influence public and private sector stakeholders to promote more IPM-friendly policies and market incentives and collaborating with research organisations.

Ultimately, there are limits to what standards schemes alone can achieve in reducing pesticide hazards, unsafe practices and promoting safer pest management strategies. This will require better government regulation and more financial commitment from supply chains and consumers to support safe and sustainable production.

Food & Fairness case study:

Reducing hazardous pesticide practice in coffee supply chains.

This case study looks at the approaches of different private standards schemes in coffee supply chains on controlling the use of hazardous pesticides and moving to safer pest management strategies. It attempts to draw some conclusions from the different schemes and highlight issues for private and public sector stakeholders in the coffee sector. The PAN UK Food & Fairness project (F&F) case study on horticulture pesticide issues focussed mainly on smallholder participation, whereas this study focuses more on farms employing workers. However, smallholders make up the vast majority of those growing coffee and the study addresses implications for smallholders too.

1. Pesticide health issues in coffee

Coffee production provides a livelihood for over 25 million people, mainly small-scale farmers, farm workers and their families, in 60 countries in the developing world. Global coffee production was estimated at over 7 million t in 2007 and coffee products generate over US$70 billion in retail sales a year (ICO, 2007). Given the importance of and profits generated on coffee consumption, particularly in industrialised countries, the coffee sector should take responsibility for providing safe, sustainable and profitable livelihoods for all those involved in growing and trading coffee. However, the use of hazardous pesticides and dangerous handling practices can have serious impacts on the health of coffee farming families and the biodiversity and natural resources in their environment. Reliance on hazardous pesticides also generates hidden economic costs for farm families, governments and society in general (see PAN UK Food & Fairness briefing *Hidden costs of pesticide use in Africa*).

Very few studies on pesticide health impacts in developing countries focus specifically on coffee. One study of 19 Kenyan coffee estates in 1993 painted a picture of appalling practice (Partow, 1995; PAN UK, 1995). Workers sprayed from six to eleven hours a day, pesticide solutions were mixed using bare hands and without use of funnels, making spillage and splashes almost unavoidable. Only 59% workers were supplied with overalls or aprons and 53% worked bare foot. Laundering was infrequent, resulting in workers using spray-soaked clothing for several days. No drinking water or soap was available to workers during spray operations. None of the workers had received formal training in mixing, loading or application of pesticides and 58% did not know the name of the chemical they were applying. Spray equipment was generally in a poor condition, with leaks common. Most workers interviewed had experienced adverse health effects, notably dizziness and eye irritation. Other common symptoms were skin irritation (84%), breathing difficulties (71%), stomach problems (58%) and nausea (20%).

While pesticide application was done by men, coffee picking was done mainly by female labourers and their children. As the picking period overlapped with pesticide application periods, women were frequently exposed when required to pick in recently sprayed areas and reported dermatitis, dizziness, nausea and vomiting.

A Tanzanian study of coffee large and small-scale farms in 1993 reported 7% of coffee farmers had experienced poisoning incidents (Ngowi et al., 2001). Poor handling practices increased the exposure risk of both coffee farmers and workers and hazardous practices were more pronounced on individual smallholder than co-operative farms. This was partly related to smallholders' use of a larger variety of pesticides, often in unlabelled and non-original containers and with dangerous mixing and storage practice.

A decade later, studies commissioned by the International Union of Agricultural Workers in 2003 showed that while working practices have improved to some extent, pesticide use in coffee production continues to pose health risks (IUF, 2005). Workers reported symptoms including dizziness, nausea, chest pain, diarrhoea, skin rash, headaches and muscle cramps. Coffee estates visited in Kenya did provide personal protective equipment (PPE) to workers handling pesticides but in many cases this was not regularly maintained or did not meet required standards. Few estates had clear instructions in local language on the use and storage of chemicals, nor was there regular training, while casual workers were not informed of the hazards they were exposed to. Some medical examinations were conducted to determine exposure levels but results were kept secret from the workers tested. Empty pesticide containers were observed being used for household purposes by some workers. Tanzanian estates provided PPE and soap and workers were expected to wash this regularly. However, enforcement of PPE use was weak and workers spraying coffee trees were at high risk of skin problems due to exposure. In neither Tanzanian or Kenyan estates were health and safety committees functioning.

More recently in Colombia, the health authorities in Quindio department, an important coffee-growing district, reported that one teenager died and 154 people were poisoned through exposure to the organochlorine insecticide endosulfan in the first eight months of 2007. Endosulfan was prohibited in 2001 in Colombia yet local authorities found that it was being used illegally by farm owners in coffee and banana. Some of these were ordering their workers to spray endosulfan, without providing PPE (RAPAL, 2007).

2. Certification and assurance schemes assessed in this study

Unlike fresh fruit and vegetable supply chains, where public concerns about and common occurrence of pesticide residues have served as a driver to improve food safety and look more carefully at pesticide practice, residues in the final coffee product at consumption stage are unusual. The UK government monitored tested 108 ground coffee samples in 2004, looking only for 11 organochlorine pesticides, as they are persistent in the environment, and may still be present after processing. No residues of these were found (PRC, 2004). Efforts to change the highly hazardous practices in coffee production documented in section 1 therefore need to focus on supply chain initiatives which address production conditions and not just food safety of the final consumer product.

Since the late 1980s numerous such initiatives have started to address different environmental, social and economic issues in coffee production by introducing private standards schemes. These operate either as certified products at retail level with a consumer label, or as farm assurance programmes at business level which verify compliance of green (i.e. unroasted) coffee production with requirements of their clients in specific supply chains. Several studies have looked at impacts, actual and potential, of different coffee standards schemes, mainly since the global coffee price crashes of the early 2000s, which hit farmers and producing countries very hard and drew media and academic attention to issues of corporate accountability in global coffee markets (Bacon, 2005; Muradian and Pelupessy, 2005; Raynolds et al., 2007). These studies cover broad aspects of smallholder livelihoods, environmental sustainability or corporate social responsibility but do not examine pesticide aspects in detail.

This case study therefore focuses exclusively on aspects of pesticide use and handling, hazard reduction and pest management. It looks at six major schemes in the coffee and private standards worlds:

- The Sustainable Agriculture Network (SAN) Sustainable Agriculture Standard, under the Rainforest Alliance label
- Utz Certified coffee “Good Inside”
- Fair Trade under the Fairtrade Labelling Organisation (FLO) standard
- EurepGAP/GlobalGAP standard for Integrated Farm Assurance
- Common Code for the Coffee Community (4C)
- C.A.F.É. Practices for the Starbucks Coffee Company

These schemes were selected as they, or the companies involved, are well-known to consumers in Europe (in the case of Rainforest Alliance, Fairtrade, Utz Certified and Starbucks) or represent major pre-competitive supply chain initiatives (in the case of GlobalGAP and the potential scale of 4C). It was not possible to compare the volumes, value or market share of global coffee trade across these schemes as they do not report in comparable terms.

Full details of each scheme can be accessed via their respective websites, given in Appendix I. Here we provide a short introduction to each, with relevant information on coffee. The standards and how they are audited are not static -most schemes are in a process of regular revision of the standards, often involving stakeholder consultation.

We do not study organic coffee here, on the assumption that the prohibition of synthetic pesticides and restrictions on the very small number of permitted pest control compounds under organic farming standards largely removes the health and environmental hazards related to pesticide use in conventional systems. This study also excludes individual retailer or food manufacturer initiatives on pesticide reduction which are generic across all crops in their food supply chains. At least three of the larger UK-based supermarkets have developed prohibited and restricted lists for specific pesticides, on a hazard reduction basis. Details of the Co-operative’s pesticide hazard reduction initiative and support for Integrated Pest Management (IPM) can be found in recent PAN UK and PAN Europe assessments (Williamson and Buffin, 2005; PAN Europe, 2007). Unilever food company is undertaking significant work on pesticide reduction and IPM (Pretty et al., in press) in its supply chains, including tea, palm oil and vegetables, although coffee is not one of the major commodities it uses in its food products.

2.1 SAN Sustainable Agriculture Standard for Rainforest Alliance

The Rainforest Alliance (RA) seal is part of the Sustainable Agriculture Network’s broader mission to improve the social and environmental conditions of tropical agriculture. It has a particular focus on nature conservation and standards were first developed in the early 1990s. It covers a range of forestry and agricultural products. The Rainforest Alliance seal is a consumer label, used by many different companies and brands. The SAN standard applies equally to large and small farms. The current version from Nov. 2005 and updated in 2008 tries to make the certification more accessible to small farmers. The majority of certified coffee farms are small and medium size.

The RA standard is not only a yes/no compliance check but aims to encourage continuous improvement under 10 social and environmental principles. To obtain and maintain certification, farms must comply with at least 50% of the criteria for each principle and with 80% of all criteria. They must comply with defined ‘Critical Criteria’. Two of the 14 Critical Criteria in the standard relate to pesticide controls.

2.2 Utz Certified “Good Inside”

The Utz Kapeh scheme (now renamed Utz Certified) was founded in 1997, aiming to provide assurance of responsible coffee production and sourcing, focussing on transparency on where its coffee comes from and how it was produced. Utz is officially recognised as the coffee programme for GlobalGAP, but unlike GlobalGAP, it has a consumer label “Good Inside”, used by many different companies and brands, and provides consumer links directly to farmers. It aims to empower coffee farmers with better market opportunities through improving quality and closer relations in supply chains.

The Utz Code of Conduct is organised and audited in a similar way to GlobalGAP, with Major, Minor and Recommended Control Points. The Code is applicable to large and small farms, with smallholders certified through group organisation. Of the 203 control points in the current (Jun. 2006) Code, 24 are obligatory requirements related to pesticides.

2.3 FLO Fair Trade

In the late 1980s the Fair Trade Labelling Organization International (FLO) was formed as the fair trade movement began to enter mainstream retail outlets. While founded primarily on social justice and better trading concerns, environmental issues have been integrated over time and large scale producers as well as smallholder associations can be certified. FLO certified products carry a consumer label and certified coffee is sold through many different companies and brands.

There are separate FLO standards for large farms with hired labour and for smallholder associations. In the case of coffee, FLO only certifies small farmers’ associations and not coffee estates. Standards are divided into Minimum Requirements, which must be met from joining the scheme, and Progress Requirements, in which improvement is documented over time, some within a 12 month period. Of the 158 requirements, 25 are pesticide-related Minimum Requirements. FLO encourages fair trade producers to convert to organic production where feasible and around 50% of Fairtrade coffee is also certified organic, receiving an additional price premium.

2.4 EurepGAP/GlobalGAP

This crop assurance scheme was initially set up by retailers organized into the European Retail Produce Working Group, focussing on food safety, traceability and good agricultural practices (GAP). The first EurepGAP established standards were produced in 2001 for fresh fruits and vegetables, and the scheme has expanded to flowers and ornamentals, arable crops, livestock aquaculture, tea and coffee. EurepGAP is a purely ‘business to business’ crop assurance scheme and not a label directed at consumers. An increasing number of food manufacturers and retailers in Europe demand EurepGAP certification in their supply chains and in 2007 the scheme was renamed GlobalGAP, reflecting its growing influence worldwide.

The GlobalGAP standard comprises over 250 control points. All Major Must Points must be complied with and a 95% average of Minor Must Points. Some control points are only recommendations. Some control point topics, such as general worker health and safety, are applicable to all types of farm system, while the bulk of the control points are covered under the generic Crop-Base protocol, with additional specific control points for the different crops or commodity types. For coffee farms, 27 pesticide-related control points are obligatory. The GlobalGAP standard is applicable to large and small-scale farms, the latter via group certification mode for smallholder associations[1]

2.5 Common Code for the Coffee Community

The concept for a voluntary code of conduct with good farming methods for improved efficiency and profitability was developed during 2003-2006, in the wake of European donor agency and NGO concerns about coffee price crashes, poverty and unsustainable practices. The Common Code for the Coffee Community (4C) aims to exclude the worst social and environmental practices and establish minimum standards, as the baseline model towards sustainability of coffee in the mainstream market. The 4C standards cover the coffee supply chain on a business-to business basis and there is no on-pack consumer label. Although 4C only started operations in 2007, the roaster and trader company members of the 4C Association represent over 60% of global coffee volumes and therefore the scheme has the potential to cover a major proportion of coffee production.

The 4C Code comprises 30 social, environmental and economic criteria. It aims to help coffee producers, traders and roasters improve practice, via a “traffic light system”, where Red Practices must be discontinued in the short term; Yellow Practices need to be improved within a transitional period and Green reflects a desirable practice. Producers and suppliers must comply with ten Unacceptable Practices, for which there is zero tolerance, and score an ‘average yellow’ across the criteria to be 4C-compliant. Of the ten Unacceptable Practices, one relates to pesticides. The Code applies equally to large and small-scale farms.

[1] PAN UK’s Food & Fairness case study *Smallholders and pesticide issues in fresh fruit and vegetable supply chains, with a focus on Senegal* explores issues of African smallholder compliance with GlobalGAP requirements, costs and benefits.

2.6 Starbucks C.A.F.E. Practices

The Starbucks Coffee Company, a major coffee roaster and retailer operating through its coffee shops worldwide, set up its own assurance scheme C.A.F.E (Coffee and Farmer Equity) Practices in 2001 to evaluate, recognize, and reward producers of high-quality sustainably grown coffee. C.A.F.E. Practices cover product quality, environmental management, economic and social aspects of coffee production and primary processing. Compliance with the guidelines is independently verified and enables suppliers to qualify for preferred supplier status for Starbucks, with the company committing to iincreasing the volume of CAFÉ Practices compliant coffee it purchases.

CAFÉ Practices comprises a set of 26 criteria, with 105 control points. Suppliers which meet or exceed 80% of the possible points in each of the 3 areas of Social Responsibility, Environmental Leadership –Coffee Growing, and Environmental Leadership – Coffee Processing, gain 'strategic supplier' status. Those exceeding 60% scores qualify for 'preferred supplier' status and those that do not reach 60% but comply with the six Zero Tolerance criteria (on minimum wage and prohibition of child labour) can qualify for 'verified' status, which must increase to 60% compliance in the second year. None of the pesticide-related control points are Zero Tolerance. Points can be scored for organic production. There are separate scoring systems for smallholder associations and for larger farms.

3. Scheme requirements related to pesticide prohibitions, phase out and use reduction

This section describes in detail the different requirements or recommendations of the six schemes related to which pesticides are permitted and efforts to reduce the toxicity and use of pesticides.

3.1 Pesticide prohibitions

All six schemes include some prohibition on specific pesticides, according to intrinsic hazard, using globally recognised classifications, such as the World Health Organisation (WHO) acute mammalian toxicity classes, or important governmental prohibition directives of the European Union or the US Environmental Protection Agency. Table 1. summarises the prohibition categories for each scheme. Appendix II details specific pesticide active ingredients prohibited in each scheme. The data in Table 1 and Appendix II both refer to all the crops included under Rainforest Alliance SAN, FLO and GlobalGAP schemes and not just to coffee certified under their schemes. For example, FLO does not permit any exemptions to its WHO Class I prohibitions in coffee, but does for some other crops, mainly certain fruit and flowers in specified countries. For specifics, the detailed scheme documents should be consulted.

Table 1. Pesticide categories prohibited under each standards scheme

N.B. 'Yes' indicates that a pesticide category IS specifically prohibited under a particular scheme.
'No' indicates no prohibition of a specific category as a whole.

Pesticide category or list	Rainforest Alliance SAN	Utz Certified	FLO FairTrade	GlobalGAP	Common Code for Coffee (4C)	Starbucks C.A.F.É. Practices
POPs list	**Yes**	**Yes**	No	No	**Yes**	No
PIC list	**Yes**	**Yes**	**Yes**	No (except 15 PIC pesticides also on EU 79/117 directive)	Yes	No (except those also WHO 1a/1b
WHO Class 1a & 1b	No immediate prohibition but growers must phase out after 3 years of certification	No	**Yes** (with some specific exemption possible on certain crops but not coffee)	No	No immediate prohibition but growers must phase out within 3-5 years	**Yes** (with some possible specific exemption requests for nematicides)
WHO Class II	No	No	No	No	No	No
PAN "Dirty Dozen"	**Yes**	No	**Yes** (with one exception possible for paraquat)	No	No	No
EU or US prohibited lists	**Yes** (some)	**Yes** (some)	No	**Yes** (some)	No	No
Methyl bromide	**Yes**	No	No	**Yes**	No	No

As there is some overlap between categories (e.g. some PIC list pesticides are also WHO Class I category) some pesticides within a category may, in fact, be prohibited by a scheme if they also feature under other categories

POPs list pesticides

The Stockholm Convention on Persistent Organic Pollutants (POPs) came into force in 2004 and includes 9 pesticides (see PAN UK List of Lists, 2005 for details), 8 of which are to be eliminated from global use, with a phase out period for DDT (which is only permitted for indoor spraying of malaria vectors). The other POPs pesticides are generally no longer manufactured or distributed, or very highly restricted for use against specific pests, such as termites. None of the POPs pesticides are registered for coffee production in major coffee-growing countries (Jansen, 2005). However, obsolete stockpiles remain in many developing countries and these could find their way into coffee production through illegal channels, especially where government enforcement of pesticide regulations is weak. Explicit prohibition of POPs pesticides is therefore useful in alerting coffee growers to the issue of POPs.

PIC list pesticides

The Rotterdam Convention on Prior Informed Consent (PIC) came into force in 2004 and includes 24 pesticides and four severely hazardous pesticide formulations. The PIC Convention does not ban pesticides globally but aims to provide an early warning system for governments. Pesticides must be banned or severely restricted for health or environmental reasons in at least two countries in two regions of the world to be considered for inclusion in the PIC List and importing countries must indicate whether they allow or prohibit their import. RA, Utz, FLO and 4C schemes have decided to prohibit PIC List pesticides. Seven organochlorine PIC pesticides are also on the POPs list. Of the 17 remaining pesticides, several are more or less obsolete and not in common use. Others, such as captafol, lindane, monocrotophos, parathion and the hazardous formulations of methamidophos and methyl parathion, are still widely used in agriculture in many countries. These pesticides are proven to be hazardous in field practice, as recognised by their PIC list status, and schemes which prohibit them thus take an active step to remove these dangerous compounds.

World Health Organisation Class I pesticides

WHO Class 1a (extremely hazardous) and Ib (highly hazardous) classes comprise 84 pesticides still in current manufacture and use, mainly insecticides, rodenticides and nematicides, for which the active ingredient is in the highest acute mammalian toxicity classes. Although 13 WHO Class Ia and Ib pesticides are listed under the PIC or POPs Conventions and some others are now in limited agricultural use, schemes prohibiting WHO Class Ia and Ib pesticides make a real contribution to protecting farm families from some of the most hazardous compounds used in coffee producing countries, including aldicarb, parathion methyl, carbofuran, methamidophos, methomyl and monocrotophos. Many WHO Class Ia and Ib pesticides are also highly toxic to non-mammalian forms of life, including beneficial insects and valuable groups for agrobiodiversity. The FAO Code of Conduct on Pesticides recommends that prohibition of the purchase of highly toxic and hazardous products, such as WHO Class Ia and Ib, may be desirable if other control measures or good marketing practices are insufficient to ensure that the product can be handled with acceptable risk to the user (FAO, 2003 and see PAN UK Food & Fairness briefing no. 3, 2007).

FLO and C.A.F.É. Practices are the only schemes to prohibit WHO Class Ia and Ib pesticides in their supply chains. Under C.A.F.É. Practices, however, farmers may use a Class I nematicide where a qualified nematologist has determined that nematodes are present in soil and coffee root samples and justified the use of the product. Farmers must then graft bushes in problem soils onto nematode-resistant rootstock in order to avoid future need for these dangerous nematicides. It is disappointing to note that FLO in its March and December 2007 revisions of its Prohibited Materials List now permits the use of 12 WHO Class I pesticides under exceptional conditions in particular countries for specific crops, mainly for flower production in all regions and fruit from South Africa, but excluding any exceptional uses in coffee. Farms claiming these exceptional conditions must justify their use with credible evidence, minimise the use and put in place a plan to substitute them.

WHO Class II pesticides

None of the six schemes prohibits WHO Class II ('moderately hazardous') pesticides as a category, although two include their phase-out over time (see next section). Evidence from many countries demonstrates that WHO Class II compounds frequently cause poisoning incidents and sometimes fatalities, particularly endosulfan, paraquat and chlorpyrifos (see PAN UK Food & Fairness briefing no. 6, on hazardous pesticides in Africa, 2007).

PAN Dirty Dozen pesticides

The PAN Dirty Dozen list comprises 18 pesticides, 15 of which are now covered under the POPs or PIC Conventions. Of the remaining three- aldicarb, DBCP and paraquat- DBCP is highly unlikely to be used in coffee these days. It is infamous for its link with sterility among thousands of Central American banana workers during its use in the 1980s. Aldicarb and paraquat are still in common use and registered in most coffee producing countries. Paraquat herbicide is responsible for numerous cases of acute poisonings among plantation workers in different continents (Isenring, 2006), despite being classified as only moderately hazardous (Class II) by WHO. Schemes which prohibit the PAN Dirty Dozen therefore remove one of the pesticides most commonly causing acute poisonings and skin disorders and frequently used in suicide attempts.

Prohibition of aldicarb and paraquat under the Dirty Dozen are particularly valuable under the RA scheme, which does not otherwise prohibit Class I or II pesticides outright. It also proves that it is perfectly feasible, technically and economically, to get rid of the controversial paraquat in large-scale agriculture. In 2007, however, FLO decided to permit exceptional conditions for the use of paraquat (WHO Class II) in Costa Rica. It is not clear why Costa Rican coffee producers should be permitted to use this hugely problematic herbicide when all other fair trade coffee producers in the rest of the world are able to manage without it. In contrast, Utz prohibited paraquat in its standard from Dec. 2007. In personal communication in May 2008 FLO explained that the coffee producers in question in Costa Rica had managed to phase out their use of paraquat.

Pesticide prohibition lists from the EU or US EPA

Three of the schemes explicitly prohibit certain pesticides prohibited by the European Union and/or the US Environmental Protection Agency. GlobalGAP prohibits only the 19 compounds listed under EU Directive 79/117 ‘prohibiting the placing on the market and use of plant protection products containing certain active substances’. These are mainly old organochlorine compounds, long banned by EU Member States, 16 of which are covered under the POPs or PIC Conventions. The majority of the pesticides prohibited by RA and Utz with reference to US and EU listings are superceded pesticides, obsolete or banned many years ago and of little relevance to coffee production today. The RA and Utz lists do contain some problematic pesticides still in widespread use globally, for example, Utz prohibits the WHO Class U fungicide benomyl, linked to birth defects, and RA prohibits the Class U herbicides atrazine and simazine, common water pollutants, potential carcinogens and suspected endocrine disruptors.

It is not always clear to which official lists or legislation RA 2005 and Utz prohibited lists refer and they are not identical. From July 2008 RA has clarified this by referring to pesticides which qualify as a ban or severe restriction in the EU[2]. FLO also includes some pesticides in its prohibited lists which appear to relate to EU or US bans but with no reference to the legislative sources. These prohibition categories may be confusing where legislation changes By the end of 2007, the EU listed 110 pesticides or formulations banned or severely restricted, yet the more recent bans do not feature in the prohibition lists of Utz or FLO. RA decided in May 2008 to incorporate them into their prohibited lists from July 2008 under a three year phase-out process (see 3.2 below) This means that PAN International target insecticide for a global ban, endosulfan, will be prohibited by RA by mid 2010, along with 53 other substances not included in its earlier prohibited lists. Some of the most recent bans by the EU include highly toxic and commonly used insecticides such as carbofuran, carbaryl and the nematicide cadusafos.

[2] See PAN UK Food & Fairness briefing no. 1 *Which pesticides are banned in Europe?* April 2008 for details.

Methyl bromide

Methyl bromide is a highly toxic fumigant which is also a potent ozone depleting gas and subject to global phase out under the Montreal Protocol. Industrialised countries were supposed to have phased out all uses by 2005, with a longer phase out period for developing countries. By 2008, the EU had phased almost all uses while the US has made only scant progress (CABI, 2008). Like all pesticide fumigants, it does not receive a WHO Class rating as these only apply to solids and liquids. It is, however, neurotoxic and mutagenic and regularly causes acute occupational poisonings. Its prohibition is therefore valuable for protecting the health of workers. Only GlobalGAP and RA prohibit it in their standards.

Other requirements on permitted pesticides

A further requirement of RA, Utz, FLO and GlobalGAP standards is that, in addition to complying with their own prohibited chemicals lists, pesticides used by farmers must be registered in the country of production (if a registration scheme exists) and approved for use for the crop on which it is applied. On the one hand, this requirement backs up compliance with national regulations on pesticides and acts to avoid unauthorised use. Yet for many countries, especially in Africa, government registration is very slow and underfunded and agrochemical companies have little commercial interest in submitting data for registering newer products for the small number of potential customers. As a result, few of the newer, less acutely toxic pesticides and biopesticides are legally approved. This requirement can make it very difficult for standards schemes to encourage their farmers to use less toxic options, if these products are not registered in-country.

Table 2. Requirements and encouragements on reducing pesticide toxicity and use.

	Less toxic prioritisation?	Use rationalisation or reduction?
RA	Encourages elimination of pesticides known for their negative impact on health and natural resources. Phase-out of WHO Class I pesticides required in 3yrs and reduction of Class II. Phase-out of further 54 substances banned in EU by July 2010.	Must demonstrate by inventories and application records that it rotates pesticides and reduces their use.
Utz	Recommends to use pesticides with least chemical toxicity possible for people, flora and fauna.	
FLO	Timing and type of chemical application should aim to minimize quantities used and threat of human or animal exposure and environmental harm. P: Demonstrates reduction in toxicity and use and improvement in rational use. P: When cultivation techniques fail or prove inadequate, should have order of preference of chemical solutions, from least toxic to more toxic options. Natural materials preferred over synthetic preparations.	Build-up of resistance avoided through appropriate production and dosage techniques and selection of appropriate plant varieties. P: Where herbicides permitted and justified, plan to reduce or eliminate future use. P: Explain rationale for the use of agrochemicals P: Where exceptionally allowed pesticides used, use is phased out over time, through planning and application substitutes. Efforts to find alternatives are documented and methods assessed by trials.
G'GAP		Where pesticides used, plant protection is achieved with appropriate minimum input.
4C	P: Keep to FAO Code recommendations regarding WHO I and II and all pesticides of low acute toxicity. P: Red criterion pesticides to be phased out in 3-5 years. Yellow criterion pesticides to be substituted over 10 years.	P: Yellow Status: Put in place system to minimize spraying.
C.A.F.E.	Farm toxic load to be calculated and decreased over time through reduction in agrochemical use or selecting less toxic alternatives (reduced risk pesticides). Aims to reduce dependence on external agrochemical inputs, measuring reductions via a weighted toxicity index score until the use of such inputs is no longer necessary.	Pesticides are applied using spot spraying based on incidence and infestation pattern.

3.2 Pesticide use reduction and selection of less toxic products

The FAO Code of Conduct on Pesticides recommends avoiding the use of the most hazardous pesticide classes and those which require the use of considerable protective equipment. "Pesticides whose handling and application require the use of personal protective equipment that is uncomfortable, expensive or not readily available should be avoided, especially in the case of small-scale users in tropical climates" (FAO, 2003).

Reducing use or phasing out acutely toxic pesticides

The Code of Conduct on Pesticides does not play a significant role in any of the schemes, although GlobalGAP draws attention to it in regard to pesticide use where national registration schemes do not exist. 4C also includes FAO Code recommendations on restricting use of WHO Class I and II pesticides, as an indicator of Yellow Practices under its improvement criteria.

Table 2. summarises scheme requirements or encouragements on reducing pesticide toxicity and/or use in the six schemes. All schemes except GlobalGAP include some requirements or progress to use less toxic pesticides. RA encourages elimination of pesticides known internationally, regionally and nationally for their negative impacts on human health and natural resources. Certified farms must have a plan for reducing use of WHO Class I and II pesticides and for eliminating WHO Class I compounds within three years of certification. Farms using these products must demonstrate that: (1) no technically or economically viable alternatives exist for the pest problem, (2) the infestation has had or would have had significant economic consequences (exceeding economic threshold of damage) and (3) steps are being taken to substitute WHO Class I and II products.

Both RA and C.A.F.É. Practices require farms to record and assess the reduction in toxic pesticide use, with the latter scheme participants expected to calculate a weighted toxicity load per farm. C.A.F.É. Practices also specifies spot treatments as a way to reduce volumes used. RA, FLO, 4C and C.A.F.É. Practices include use reduction as an aim, although it is not clear how easily this could be assessed.

The 4C Code background documents establish Red, Yellow and Green criteria pesticides, corresponding to its traffic light scheme for continuous improvement. It sets WHO Class 1a and Ib compounds as Red criterion compounds, to be substituted with other control measures within a period of three to five years. Under Yellow criterion are moderately hazardous WHO Class II compounds and other pesticides with less acute toxicity but with cholinesterase-inhibition (affecting the nervous system). Yellow criterion pesticides have to be substituted with less toxic substances or other control measures over ten years.

Addressing chronic health effects of pesticides
Chronic damage may result from long term exposure to pesticides, even at low dose. Chronic health effects can include disruption to the nervous, reproductive, hormone and immune systems, damage to genetic material, birth defects and cancer, and neurobehavioural and psychological changes, including a link with Parkinson's Disease. The WHO estimates that long-term exposure may result in 735,000 people suffering chronic defects and a possible 37,000 cancer cases each year in developing countries (WHO, 1990).

The 4C Code is the only scheme which considers carcinogenic and endocrine-disrupting properties in its hazard assessment, as well as acute toxicity. Under its Red criterion pesticides**,** it includes compounds that are not acutely toxic but with very strong evidence to be carcinogenic or with known and probable endocrine disrupting effects. Red criterion pesticides for 4C (in addition to those covered under WHO Class 1a/1b) are: the fungicides anilazine; benomyl; chlorothalonil; cyproconazole; iprodione; mancozeb; tetraconazole; and thiophanatemethyl, the insecticides endosulfan; methoxychlor; and propargite, and the herbicides: 2,4-D; acetochlor; alachlor; diuron; and paraquat. Chronic effects criteria for its Yellow criterion pesticides are: strong evidence to be carcinogenic; and suspected to be an endocrine disruptor. As the 4C Code is only operational since 2007, its Red and Yellow criterion pesticides (details in Jansen, 2005) have yet to be phased out. Nevertheless, the inclusion of chronic health effects is a welcome step forward for protecting farmers, workers and their families in coffee producing countries.

Reducing use of pesticides
Reducing use and dependency on pesticides as the main form of controlling pests, diseases and weeds is required or recommended by several schemes, as summarised in Table 2. Yet the requirements are often framed in terms of encouragements or rather unspecific aims, without concrete targets or timelines. It is therefore hard to assess how far the standards schemes have gone in reducing reliance on pesticides or how progress could be monitored and compared. Reducing reliance on pesticides is closely linked with implementing Integrated Pest Management and using non-chemical alternatives, described in section 4.6.

4. Scheme requirements on pesticide handling aspects, health and environmental protection and pest management strategies

In the tables, 3-11 text in **bold** indicates specific criteria or control points which must be complied with in order to achieve certification or verification, i.e. for which there is 'zero tolerance' under a specific scheme. P indicates criteria which are either recommendations or requirements for progress over time. Other text indicates normative requirements which should be complied with, but where non-compliance does not automatically mean exclusion from the scheme. For ease of reading, the tables contain shortened or paraphrased synopses of many of the pesticide-related requirements and consolidate some that are contained in separate control points. For the complete text, readers should consult the relevant scheme documents.

The 4C Code has no specific requirements on many of these critical aspects and it remains to be seen to what level of detail independent verification will look at these under its worker health and safety and agrochemicals principles. However, it should be noted that 4C is a baseline entry scheme, which aims at bringing in farms which are currently carrying out poor practices, in order to improve them, rather than excluding them from the scheme. It is in the process of developing guidelines for indicators of Red Practices and 4C-compliant farms would need to introduce procedures and equipment to avoid unhealthy or dangerous practices in order to progress to Yellow status.

4.1 Health and Safety policies

RA, Utz, FLO and G'GAP all require health and safety (H&S) policies to be in place (Table 3.). Only Rainforest, FLO and C.A.F.É. Practices have explicit requirements for workers to be involved in health and safety policy reviews, while formal H&S committees are only required by RA and FLO. Findings from the academic literature on pesticide exposure show that changing hazardous practices requires farmers and workers to be empowered to do so, rather than merely instructed what to do (Arcury and Quandt, 1998; London et al., 2003). Establishing effective worker or smallholder participation in health and safety programmes should not be overlooked in favour of prioritising controls on pesticide handling.

Table 3. Health & Safety policies and worker involvement

	Obligatory H& S programme?	Worker involvement?
RA	Yes	Yes, in reviewing policy & procedures. Occupational health committee should be set up on farms with > 10 permanent workers.
Utz	H&S risk analysis & action plan and responsible person should be identified.	Recommended for workers & H&S officer to meet regularly.
FLO	**H&S policy must be in place & trained. H&S Officer must be appointed.**	Risk assessment done jointly with workers & their representatives. Within one year occupational Health & Safety Committee with workers' representation is established.
G'GAP	Should have written risk assessment and H&S and hygiene policy and procedures. **Must have management member responsible for this area.**	Recommended for regular 2 way communication on H&S and welfare.
4C	Yellow status: procedures and equipment to avoid unhealthy and unsafe working practices exist.	
C.A.F.É.	No explicit requirement on H&S policy.	Written protocol for workers and management to review safety procedures and training in the event of accidents, exposures to hazardous materials or spills.

4.2 Training for pesticide handlers

All schemes except 4C emphasise the importance of training for all those handling pesticides (Table 4). 4C includes the principle of skills training for workers but does not specify this for pesticide aspects. RA has the most detailed requirements. RA, FLO and C.A.F.É. Practices also require regular or continuous training. This is important because one-off training is unlikely to be sufficient to reduce hazardous practice. It is also important that training includes in-depth hazard awareness components rather than just correct procedures for handling pesticides, but it is not clear how far the schemes may do this. RA states that all those coming into contact with pesticides must be trained and not only those directly handling them. This contributes to reducing the risk of harm to all those working on the farm. Numerous poisoning incidents have occurred in large farms (not necessarily coffee farms) in industrialised and developing countries where pickers or other workers have been sent into fields recently sprayed (e.g. Rozas, 2006). Therefore pesticide awareness training is necessary for all workers, as well as strict procedures and signage to prevent such exposure.

PAN has long argued that the term 'safe use' of pesticides gives a misleading message about the level of risks as the realities of poverty, poor education and lack of hazard awareness in developing countries make it impossible to guarantee that pesticides can be used safely or according to label instructions. FAO recognised this serious problem and the Code of Conduct now insists that the pesticide industry is more careful about the language it uses. As a result, CropLife recently renamed its pesticide stewardship training programmes as 'responsible use'. Standards schemes should avoid the term 'safe use' and make sure that training emphasises hazard awareness, including long-term health effects, how to recognise and treat poisoning symptoms, as well as correct handling procedures to reduce exposure and risk. In PAN's view, training materials distributed by the agrochemical companies do not address hazard awareness adequately and PAN groups and others have produced specific handbooks for training farming communities (PAN Asia Pacific, 1999; Hesperian Foundation, 2005).

Table 4. Training for pesticide handlers

	Main requirements	Progress requirementsor further details
RA	Must have permanent & continuous training and workers trained before starting work. Farmers with > 10 workers must keep records of training. Trainers must have proven knowledge & experience.	Specific training obligatory for all workers handling or coming into contact with agrochemicals: correct use of PPE; pesticide names, toxicity or mode of action; interpreting labels & Material Safety Data Sheets; measures to prevent and reduce health & environmental harm; emergency procedures for poisonings; correct handling & application techniques.
Utz	**Must train all workers handling hazardous pesticides on H&S.**	
FLO	**Workers engaged in any potentially hazardous work must be adequately trained at regular intervals by a recognised institution or specialists.**	Workers are aware of health and environmental risks of the products they are handling and able to take correct emergency actions in the case of accident. Improved, continuous H&S training recommended, incl. new, reassigned workers and seasonal and subcontracted workers.
G'GAP	**All workers handling pesticides must have certificates of training or proof of competence.**	All workers should receive adequate H&S training.
4C		
C.A.F.É.	At least annual training covering at least: use of PPE, safe handling of hazardous materials, operation of equipment and personal safety/hygiene. Records document instructors, materials and attendance.	Regular safety meetings for all workers applying pesticides.

4.3 First aid and health, protective equipment and hazard communication

All schemes except 4C have broadly similar requirements on first aid and some aspects of health protection (Table 5). Providing first aid kits and access to water for eye washing or showering is crucial in the case of accidents. Protecting vulnerable groups from direct exposure to pesticides is required by three schemes. RA, FLO and C.A.F.É. Practices all specifically prohibit minors under 18 or pregnant and nursing women from applying agrochemicals and for those applying pesticides to do so for more than 6 hours a day, or 4 hours in the case of FLO. FLO and RA operate the strictest and most detailed requirements on health protection and both require, rather than recommend, regular medical checks.

Schemes with the exception of 4C all require obligatory provision of personal protective equipment (PPE) and include some requirements on communicating hazard information (Table 6). They all put emphasis on the need for clear communication and warning signs to show which plots have been recently sprayed. Only RA, however, includes communicating spray warnings for neighbours, as part of their standard specifically covers community relations. This is important, especially on large farms, where pesticide application may affect people and agroecosystems beyond the immediate workers.

G'GAP puts the most emphasis on consumer protection, with the most detailed requirements on respecting pre-harvest intervals and also requires farmers to participate in regular monitoring of residues in their crops and explicit knowledge of Maximum Residue Levels in customer market regions. This is not surprising given GlobalGAP's origins in food safety assurance.

Table 5. First aid & health protection

	First aid	Health protection
RA	All workers must be familiar with emergency procedures relevant to their duties. Farm must have workers trained in 1st aid available on every shift. 1st aid kit must be available in permanent installations and kit available to field workers. Shower, eye wash and sink must be available in storage and mixing areas. .	Workers handling agrochemicals must have at least annual medical checks on physical & mental capacity to work and access to results. Workers handling agrochemicals must have cholinesterase exam before starting work. Where OPs and carbamates applied, must have cholinesterase tests at least every 6 months. Workers must have access to records and be assigned to other duties if tests show them unfit to apply pesticides. Only males aged 18-60 and in good health may apply agrochemicals. Supervisors must check at least every 3 hours all workers applying WHO Class I and II pesticides. Workers must not apply pesticides for more than 6 hours per day, to limit exposure and minimise risk of accidents.
Utz	Should be at least one person trained in 1st aid available within a few minutes. For SSF, there should be one trained person for every 50 producers. Training must be documented and within last 5 years. 1st aid box should be available at all production locations (or at a central point for SSF) and farm must have written accident procedures and contact names/numbers. Storage and mixing areas should have eye wash, clean water within 10metres and accident procedure info contact names/numbers.	Recommended that workers applying hazardous pesticides receive annual health checks, documented and in compliance with national or industry standards.
FLO	1st aid boxes must be present and quickly accessible. A reasonable number of workers (in relation to farm size) are trained in 1st aid. Must guarantee free transport to nearest hospital during working hours, or provide free on-site permanent medical Support, equipped to deal with accidents and acute poisoning.	Potentially hazardous work must not be done by people: under 18 years; pregnant or nursing women; with incapacitating mental conditions; with chronic, hepatic or renal diseases; with respiratory diseases. Workers must not spray for more than 4 hours per day and are relieved periodically via job rotation. Workers handling pesticides are given free and confidential medical examinations at regular intervals (according to exposure levels) by a physician, with adequate liaison with a medical officer of their choice
G'GAP	Pesticide storage and mixing areas should have eye wash facility and clean water available within 10metres, 1st aid box and clear accident procedures and contacts. Should be at least one person trained in 1st aid present. 1st aid box should be available at all sites and can be transported to vicinity of the work.	Recommended that workers in contact with pesticides receive voluntary annual health checks, documented and in compliance with national or industry standards, respecting legality of disclosure of personal data.
4C		
C.A.F.É.	Should make contingency plans for handling pesticide spills and overexposure. All workers who handle/mix/apply agrochemicals have access to eye baths, hand washing and showers post-handling of agrochemicals.	Authorized minors and pregnant women prohibited from handling or applying agrochemicals. Hours worked in pesticide application are restricted in accordance with regional laws or limited to 6 hours per day, where these do not exist. Worker housing has buffer zones from productive area and agrochemical storage facilities sufficient to prevent agrochemical exposure.

Table 6. Personal protective equipment (PPE) and hazard communication

	PPE	Hazard communication
RA	**All workers in contact with agrochemicals, including washing clothes and equipment, must use PPE**. Farm must provide this in good condition and must provide incentives to workers to use it. Detailed list of PPE required. Must have showers and changing rooms for all workers in contact with agrochemicals and require them to shower after application. Must be exclusive & separate areas for washing PPE and for washing application equipment. Clothes worn while applying agrochemicals must never be washed in workers' homes but in designated area near changing rooms, with handling procedures defined.	All areas used for storing and mixing agrochemicals must have signs legible at 20 metres to indicate type of products, dangers and precautionary measures. Farm must take permanent action to protect workers, neighbours and other persons from effects of agrochemicals and biological or organic inputs. Must identify groups most exposed to applications and have mechanisms for alerting them in advance of application dates, areas and re-entry restrictions. Warning signs must be used to prevent unauthorised persons entering application areas and workers must know and respect restricted entry and pre-harvest periods. For products with no established restricted entry periods, must apply 48-72 hours (WHO I), 24-48 (WHO II) and 4-12 hours (WHO III & IV).
Utz	**Must equip all workers and sub-contracted workers with suitable clothing and equipment in good repair** so that pesticides can be applied safely according to label instructions. For home-made and/or traditional products, this must be done whenever they pose a health risk. Should ensure and demonstrate that all workers who use PPE do so according to label instructions. PPE should be stored separately from pesticides in a well-ventilated area.	**Must make all people on farm aware of concept of re-entry times and have visual warning signs in place.**
FLO	**Workers, including temporary ones, handling hazardous chemicals must be provided with adequate PPE of good quality and in good condition at company expense. Workers must always use such equipment and never take it home. Workers must regularly replace filters in PPE.** **After spraying workers must rinse equipment, wash PPE before undressing and shower.**	Safety instructions, re-entry intervals and hygiene recommendations should be displayed clearly in a visible place in the workplace. Local language(s) and pictographs should be used. Re-entry intervals are strictly observed and foliage must be completely dry before harvesting or other work is undertaken.
G'GAP	**Complete sets of protective clothing must be available and in good repair.** **PPE must be regularly cleaned and washed separately from private clothing. PPE must be stored separately from pesticide products.**	**Must be clear documented procedures regulating re-entry periods according to label instructions**. Records show that re-entry periods are monitored. Safety advice for hazardous substances should be accessible. Permanent and legible signs indicating hazard should be on pesticide stores and on treated crops.
4C		
C.A.F.É.	**Employer must provide PPE to all applicable employees at no cost** (masks/respirators, goggles, rubber boots, water-proof gloves, overalls and ponchos). Workers should use PPE. Should provide showers and facilities for washing clothes post-agrochemical application.	Agrochemicals are only mixed and spraying equipment loaded in agrochemical storage areas. Workers do not enter areas where pesticides were applied in the prior 48 hours without PPE.

4.4 Pesticide application equipment, practice and record keeping

Tables 7 and 8 cover aspects of how pesticide applications should be made, equipment maintenance, calibration and hygiene and record keeping. All schemes with detailed requirements stipulate obligatory inventories of pesticide stocks and application records. Utz and FLO also stipulate that these documents include specific poisoning symptoms for each pesticide. FLO also asks for records of best practices to avoid exposure and of significant mishaps involving pesticides. Most schemes also require some form of justification of pesticide applications (included under record-keeping or pesticide application practice control points) but it is not clear whether these amount to more than just naming the target pest, disease or weed, or a more detailed explanation of why chemical control was needed for each application. How justification of pesticide applications is documented and assessed in audits illustrates one of the major challenges for private standards in questioning current dependency on pesticides and promoting real change in attitudes and practice.

Table 7. Application practice and equipment

	Mixing and application	Equipment, washing & maintenance
RA	Facilities and procedures must exist for correct mixing and application.	Equipment should be maintained and calibrated to minimise waste and excessive application, by trained personnel. Equipment washing water must be collected and not mixed with domestic wastewater or discharged without treatment.
Utz	Detailed requirements on disposal of surplus mix or tank washings.	Should maintain equipment to ensure correct functioning, calibrate annually. and show maintenance records.
FLO		Suitable and properly calibrated spray equipment is used, receives regular maintenance and is cleaned after each application.
G'GAP	Facilities to enable correct filling and mixing as per label instructions. Detailed requirements on disposal of surplus mix or tank washings. **Pre-harvest intervals must be respected, with warning signs and timings posted to ensure compliance in continuous harvesting situations.**	Equipment to be kept in good repair with annual maintenance and inspection. Recommended to obtain independent equipment calibration certification, where this exists.
4C		
C.A.F.É.		Spraying equipment is maintained in good working order and cleaned after use in agrochemical storage areas.

Table 8. Record-keeping

	Main requirements	Further details
RA	Must maintain inventory of pesticides with commercial and generic names, amounts and dates acquired. Field application records must include: product applied and date; plot; application area; dose and total volume; names of persons authorising application and mixing and applying; equipment used.	Records must be kept for 5 years and summarised to determine application trends for specific products. Must demonstrate product rotation.
Utz	**Must keep annually updated inventory of all pesticides used and stored**. For all hazardous pesticides, this must include and 1st aid treatment. List must include brand name and active ingredient, poisoning symptoms, national pesticide regulation updates. Field application records must include: product applied (brand name & active ingredient) and date; plot; application volume per ha or plot; names of persons authorising application and mixing and applying; equipment used; re-entry time; first allowed harvest date; justification (disease or pest name).	Specifically includes record-keeping for treatments on coffee nurseries.
FLO	**Must have purchase receipts, records of use and an inventory of all chemicals used**. Application records to dates, materials, dosages, areas treated, methods of application and target pest(s), and traceable to plot. **Must record significant mishaps** (e.g. unintentional use or accidental exposures, spills) and have system for remedial action.	Should demonstrate understanding of timing, dosage, target pest(s) or problems, and method of application appropriate for each product. Must understand effects of each chemical on human health and best practices to avoid exposure.
G'GAP	**Field application records must include: crop treated, product applied (brand name & active ingredient) and date; plot location; operator name; names of persons authorising application; volume and dose; equipment used; pre-harvest interval; justification (disease, weed or pest name).**	Should keep annually updated inventory of all pesticides used and stored, incl. brand name and active ingredient, national pesticide regulation updates.
4C		
C.A.F.É.	**Farms must maintain purchase records of pesticides, (specifying date, product, formulation, quantity, supplier and price of each).** Should maintain application register (specifying the date, product, formulation and quantity).	

4.5 Pesticide storage, disposal and empty containers

Tables 9 and 10 cover aspects of storing pesticides and disposal of empty pesticide containers and obsolete stocks.

Storage facility requirements exist for all schemes except 4C, with Utz, G'GAP and RA having the most detailed specifications for store construction, facilities and location. The PAN UK F&F case study on horticulture discusses in more detail issues of achieving reduced risk storage of pesticides by smallholders, which is often done in a highly hazardous way among untrained farmers. In general, organisations with experience in smallholder horticulture organisation for G'GAP compliance have found that centralising pesticide storage at local level, with trained personnel organising distribution to individual farmers, works best to reduce risks and ensure compliance.

Table 9. Storage practice

	Main requirements
RA	Must store in a manner that minimises harm to health & environment and only store amounts to meet short-term needs. Detailed requirements on store construction, spillage retention, ventilation, light, labelling, signage and product separation. Store location must be separated 60m from buildings and 200m from water sources for human consumption, if national regulations do not exist, or stores do not comply with some of the detailed requirements. Includes requirements on transporting pesticides.
Utz	Detailed requirements on store construction, spillage retention, locking, fire resistance, ventilation, light, labelling, signage and product separation. Must include up to date inventory, with info on poisoning symptoms and 1st aid for each product.
FLO	**Hazardous chemicals must be stored in a separate, safe and locked room and issued by a qualified person.** Instructions on store facilities, spillage retention, ventilation. Agrochemicals stored correctly according to their toxicity, to avoid risk to humans and environment.
G'GAP	Detailed requirements on store construction, spillage retention, locking, fire resistance, ventilation, light, inventory, labelling, signage and product separation.
4C	
C.A.F.É.	Must store agrochemicals in a locked place with controlled access. Detailed requirements on spillage retention, ventilation, labelling, original packaging and product separation by toxicity.

Table 10. Empty containers and disposal

	Container treatment	Container disposal
RA	Empty containers must be triple-rinsed before being stored for disposal or returned to supplier.	Must take action to return obsolete stocks to supplier. If supplier will not accept them, farm must seek safe alternatives for disposal.
Utz	Should not re-use empty containers and these should be stored securely until disposal. Containers should be triple-rinsed and then perforated to prevent re-use.	Should use official collection schemes if available, follow national regulations or if neither exist, dispose of containers in a manner that avoids or minimises exposure to humans, environment and food products. Obsolete stocks should be labelled and stored securely and disposed of as above.
FLO	Should control reuse of containers to prevent use in food and product storage/transport and plan for disposal of potentially hazardous containers.	Unused pesticides returned to supplier if possible.
G'GAP	**Empty containers must be triple-rinsed and should be stored securely until disposal.** Use of empty containers should not occur and should be disposed of avoiding human exposure and environmental contamination, using official disposal schemes where available.	**Relevant regulations on disposal must be observed.** Obsolete stocks should be identified and securely stored.
4C	Safe waste management is in place.	
C.A.F.É.	Recommends pesticide containers are triple-rinsed and punctured before disposal or recycling.	

Re-use of empty containers to store food and drinking water is a major hazard and common practice among untrained smallholders (see PAN UK F&F briefing no. 4 *Pesticide food and drink poisoning in Africa*) and can sometimes be seen on large farms too. All schemes except 4C require that such re-use is prevented, with four schemes stipulating that empty containers are triple-rinsed. Utz and C.A.F.E. Practices also require that containers are punctured so they cannot be used for household purposes. Container collection schemes do not exist in many countries so it is very important that empty containers are kept in a secure place out of the reach of possible misuse. These requirements make a valuable contribution to tackling one of the problematic but less visible aspects of hazardous pesticide practice.

4.6 *Environmental protection, Integrated Pest Management and GM crops*

Tables 11-14 cover environmental protection requirements in relation to pesticides (mainly buffer zone measures to protect water courses), requirements or encouragements on implementation of Integrated Pest Management (IPM) and the scheme policies on cultivation of genetically modified (GM) crops.

All schemes, except 4C, have obligatory requirements to avoid pesticides being applied close to water bodies. 4C includes a principle on conserving water quality so it is likely that more specific requirements may be introduced as part of identifying Red practices to be eliminated within 3-5 years. The establishment of buffer and/or no-spray zones around water bodies not only helps protect wildlife and biodiversity but also protects the health of communities nearby and downstream who may use these sources for drinking and household water. The schemes vary considerably in the width of buffer zone around water bodies or courses, from 5m for Utz and G'GAP to 50m for RA under its highest risk scenarios. FLO and RA have the most detailed buffer zone requirements, which cover not only water bodies but also drinking water sources, forest areas and public roads. RA has an appendix stipulating high, medium and low risk scenarios and separation distances according to: level of use of pesticides: frequency of application, type of spray equipment; and slope of the terrain. C.A.F.É. Practices also restricts herbicide use, in order to reduce soil erosion, and FLO favours cultivation methods over chemical weed control and reduction in herbicides, as part of progress requirements.

All the schemes include promotion of IPM and/or Integrated Crop Management but vary in the priority and detail. None of them include IPM as a critical control point but RA and C.A.F.É. Practices both require written IPM plans, field monitoring to assess the need for control interventions, and prioritise the use of non-chemical methods over pesticides. C.A.F.É. Practices includes specific guidance and awards points for using trapping methods for coffee berry borer, one of the key pests affecting coffee quality in Latin America.

Table 11. Environmental protection in relation to pesticides

	Water protection and buffer zones	Other environmental aspects
RA	Must have minimum separation (5m) between production areas and natural ecosystems. Native vegetation zones must be established between the crop and areas of human activity, including public or frequently used roads, to reduce agrochemical drift. Specific separation distances of production areas from water bodies, roads and buildings, according to slope of terrain and level of use of agrochemicals (toxicity and frequency) and type of spray equipment. 10m is most common scenario. For highest risk scenario, 50m separation on slopes to protect springs when aerial or spraybooms used.	If total or partial compliance with RFA water contamination standards cannot be proven, farm must conduct surface water quality analysis, including pesticides, until it can be proven that farm activities do not contribute to quality degradation of natural water bodies.
Utz	**Pesticides must not be used within 5m of any permanent water stream**, with clear instructions for workers to comply with this requirement.	
FLO	**Aerial spraying only permitted for fungicide**. Aerial spraying over buffer zones, open water bodies or residential areas is not undertaken. Buffer zones to be maintained around virgin forest (100m) drinking water sources (100m), water courses (20m) and roads (2-20m).	P: Animals are not fed with crop waste that is contaminated by pesticides. P: Waste water must not pollute water or contaminate soil or crops with chemicals. P: Where herbicide use is justified, timelines and activities to reduce or eliminate their use should be planned and monitored.
G'GAP	**Clear instructions must be in place and documented for not using agrochemicals within 5m of any permanent stream.**	
4C	Water resources are conserved in quality and quantity terms.	
C.A.F.É.	No application of agrochemicals permitted within 10m of any water body or course. Nematicides should not be applied within 20m of any water body or course.	To reduce soil erosion, herbicides should not be used to control ground vegetation/cover crops and are only used in spot applications for aggressive weeds.

Table 12. Implementation of IPM and alternatives to pesticides

	IPM principles and decision-making	IPM methods mentioned
RA	Includes specific section on Integrated Crop Management. Must have an IPM programme based on ecological principles for control of harmful pests.	Programme must include monitoring pest populations, training of relevant personnel in monitoring and IPM techniques. Farm must collect and record info on pest infestations, incl. date, duration, location, pest type, control methods used, environmental factors during infestation, damage caused and estimated costs of damage and control. Programme must give priority to physical, mechanical, cultural and biological control methods and least possible use of agrochemicals.
Utz	Should apply recognised IPM techniques where they are technically feasible. Producer should explore non-chemical alternatives for pesticides and be able to show documented evidence. Recommended that if external advisor is responsible for implementing IPM techniques, he can demonstrate technical qualifications. For producers, they can show they have received formal documented training.	Recommendation to choose varieties best suited to local conditions and take important pests and diseases and required amounts of pesticides into consideration.
FLO	Expected to minimize the use of synthetic pesticides, partially and gradually replacing them with biological disease control methods. Encouraged to work towards organic practices where socially and economically practical.	P: Cultivation techniques for weed control should be practiced regularly as part of a broader agronomic system. P: Expected to continuously seek less toxic alternatives. Cultivation techniques should form the basis of creating ecosystems that foster natural plant vigour/resistance and ecological equilibrium
G'GAP	Specific section on IPM in latest version. Technically responsible person on-farm should have formal documented training or external consultant can demonstrate technical qualifications. Producer can show evidence of implementing at least one activity in each of 3 categories: Prevention (adopting cultivation methods that could reduce incidence and intensity of pests attacks, thereby reducing the need for intervention) Observation & monitoring (determining when and to what extent pests and natural enemies are present and using this information to plan what pest management techniques are required) Intervention (where pest attack adversely affects the economic value of a crop, intervention with specific pest control methods takes place. Where possible, non-chemical approaches must be considered)	Should consider pest and disease resistance/tolerance during variety selection. Where the level of a pest, disease or weed requires repeated controls, anti-resistance recommendations are followed, if specified on product label. Prevention methods include: Crop rotation; pest exclusion and soil management; selection of appropriate varieties and planting material; good crop hygiene. Observation & monitoring methods include: crop monitoring; using decision support systems as a means to identify the need for, and/or timing, of intervention strategies. Intervention methods include: using pesticides selectively and in ways that reduce the risk of resistance developing; use of natural enemies and other commercially-available biological methods of control; other methods to control pests. IPM Annex to Crops Base control points provides more generic guidance on possible IPM techniques for each category.
4C		P: Green status: Integrated Crop Management methods (shade, fertilisation, varieties, plant density) used to prevent phytosanitary problems. Use of natural enemies and least toxic pesticides is practiced.
C.A.F.É.	There is a written Integrated Pest Management Plan and properly implemented. Aims to develop agro-ecosystems capable of naturally maintaining pests, disease, and competing vegetation at insignificant levels.	Agrochemicals only applied after cultural and physical controls have failed. Farm has a plan for monitoring for insect and disease problems and symptoms of nematode infestation and implements regular monitoring. Workers take physical action to control sources of infestation (i.e. removal of infested cherries or ethanol/methanol based traps set during appropriate phase of pest life cycle).

Table 13. IPM definitions used under each scheme

	IPM definition used
RA	Integrated Crop Management Certified farms contribute to the elimination of hazardous agrochemicals through integrated crop management to reduce the risk of pest infestations. The farm must have an integrated pest-management program based on ecological principles for the control of harmful pests (insects, plants, animals and microbes). The program must give priority to the use of physical, mechanical, cultural and biological control methods, and the least possible use of agrochemicals. The program must include activities for monitoring pest populations, training personnel that monitor these populations, and integrated pest management techniques.
Utz	IPM definition used: IPM is 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 environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural and or non-chemical pest control mechanisms. It is a system of practices designed to choose the most economical and environmentally friendly course of action in controlling pests. Fundamental is the concept of knowing what the problem is before pesticides are applied. Scouting the crops for pest infestation and comparing the cost of pest damage with the threshold cost of pesticide application helps to reach a decision on when to spray or not to spray. Explanatory guidance in relation to IPM implementation: Fundamental to IPM is the concept of knowing what the problem is before you apply pesticides. Comparing the cost of the damage caused by a pest or disease with the cost of the appropriate application helps to decide on when to use the crop protection product or not. Definition adds that the best IPM-practices in coffee are region-related. Requests producers to consult their national coffee association for publications.
FLO	No specific definition used.
G'GAP	IPM definition in Annex 1 IPM to Crops Base protocol: Integrated Pest Management (IPM) involves the careful consideration of all available pest control techniques and the subsequent integration of appropriate measures that discourage the development of pest populations1, and keeps plant protection products 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 healthy crops with the least possible disruption of agro-ecosystems and encourages natural pest control mechanisms. EUREPGAP sees IPM as an important strategic discipline contributing to food quality, food safety, farmers' and workers' health, and quality of the environment. IPM requires a planned approach to crop protection, including a variety of methods, and tools, to manage pests effectively according to local conditions. In order to help farmers and certification bodies alike, EUREPGAP has defined in the guidelines below, those activities which will be regarded as making a genuine contribution to IPM. These guidelines are applicable in general terms to all crops, but local differences between crop type and production methods will mean that the IPM techniques listed are not fully prescriptive of all IPM methods. There may therefore be some need for local interpretation of the guidelines and the future inclusion in these guidelines of additional methods that are compatible with IPM approaches.
4C	No specific definition used.
C.A.F.É.	No specific definition used. Evaluation guidelines objectives for Ecological Pest and Disease Control: Environmental leadership in coffee growing aims to develop agro-ecosystems capable of naturally maintaining pests, disease, and competing vegetation at insignificant levels. In order to diminish the farms dependence on external agrochemical inputs, a reduction in a weighted toxicity index score for all agrochemicals applied on the farm is achieved until the use of such inputs is no longer necessary.

Table 14. Scheme requirements on GM crops

	GM cultivation policy
RA	No GM crops permitted (zero tolerance requirement) The farm must take steps to avoid introducing, cultivating or processing transgenic crops. When nearby transgenic materials are accidentally introduced into a certified farm's crop, the farm must develop and execute a plan to isolate the crops and provide follow-up in order to comply with the requirements of this criterion.
Utz	No prohibition of GM coffee or other GM products. If GM coffee becomes commercially available, must comply with all relevant regulations in country of production once he is involved in (trial) plantings of GM coffee. Producer should document and inform his client once he is involved in (trial) plantings of GM coffee.
FLO	GM cultivation prohibited. GM seed or planting stock must not be grown nor GM products used, including in farm's produce not destined for Fairtrade labeling. Several progress requirements related to avoiding contamination from possible GM cultivations by neighbouring farms and traceability issues.
G'GAP	No prohibition on GM crops 5 control points on use of GMOs where GM varieties are used. Major Musts are compliance with all applicable legislation in country of production; informing clients of grower's use of GMOs; separate storage of GM crops to avoid mixing with conventional produce.
4C	Temporary 'moratorium' on GM Rules of Participation (finalised 2006): 4C coffee is grown without the use of genetically modified organisms. Within the 4C supply chain, participants will neither cultivate genetically modified coffee plants nor market genetically modified coffee. The latter agreement will be reviewed five years after the acceptance of this document by the Steering Committee of the Common Code Initiative.
C.A.F.É.	Not mentioned.

Utz and FLO place IPM implementation at progress or recommendation level, as does 4C. Until 2007, G'GAP protocols did not include any control points on IPM. Following criticism of their lack of progress in implementing IPM, the latest protocols (obligatory from 2008) now include a section on IPM and requirements at 'minor must' level for farms to include at least one activity to prevent pest incidence, monitor pest levels and to at least consider non-chemical approaches.

None of the schemes use the IPM definition in the FAO Code of Conduct on Pesticides[3]. PAN UK, however, supports the use of the FAO Code IPM definition and advocates its adoption by food sector companies since this definition has been agreed globally by governments, the agrochemical industry and public interest groups (see PAN UK F&F briefing no. 3 *The FAO Pesticide Code of Conduct: new responsibilities for food sector companies* for more details).

As with implementation aspects of pesticide reduction and selection of least toxic options discussed in section 3.2, it is hard to see from the standards documents alone how far each scheme can move farms into reducing reliance on pesticides and implementing meaningful progress in IPM. Does the certification or verification process make any form of assessment on how far along the IPM continuum farms have travelled, or does it merely check rather tokenistic aspects, such as having a written plan, but not how well it is implemented?

To date, there is no genetically modified coffee planting stock or coffee beans commercially available or traded, although research and trials of GM coffee planting material are conducted in several coffee producing countries. It is not clear when GM coffee might be available for farmers to plant or at consumer level, nor whether this would be labelled or how segregation from non-GM coffee would be organised, nor whether consumers and retailers would accept GM coffee products. RA and FLO both prohibit any use of GM crops in general in their schemes, while 4C decided during the development of the Code that a five year 'moratorium' on any use of GM coffee would be included. This 'moratorium' maybe extended or dropped in the future, if and when GM coffee planting material becomes available.

[3] ***IPM** means the careful consideration of all available, and subsequent integration of appropriate, pest control techniques 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 of agro-ecosystems and encourages natural pest control mechanisms.*
(Terms and Definitions, Article 2).

5.1 Assessing performance?

It is is one thing to look at the requirements of these schemes on paper but another to assess how they perform in practice and what actual benefits they deliver. Although the certification or verification processes extract and document a huge amount of data on compliance with each scheme's criteria, almost none of this is available in the public domain for public interest groups, government decision makers or consumers to make use of. This makes it almost impossible to make assessments of the achievements, if any, of different schemes in facilitating real changes in aspects such as pesticide reduction or implementation of pest management strategies that do not rely on pesticides as their main component. There is a major data gap on how far certification and crop assurance standards actually reduce pesticide-related ill health in farming communities or environmental damage.

This lack of impact evidence has been highlighted by many organisations and some argue instead for standards that focus on delivering measurable impacts, rather than on prescribing prohibited or favoured practices. The International Social and Environmental Accreditation and Labelling Alliance (ISEAL), whose members include FLO and RA, has recognised the need to collect such evidence beyond anecdotal level and is starting to develop initiatives to do so systematically. Some organisations and initiatives have responded by developing quantitative impact indicators which can be readily and cheaply measured at farm level. For pesticides, these generally involve some form of toxicity index, calculated by using farm records of pesticide products and application volumes and relating these to globally available data, mainly WHO toxicity class data or toxicity lethal dose data available in databases, for specific invertebrate, bird and fish species. The problem with this approach is that while it can calculate reductions in toxicity load of pesticide applications on crops, or concentrations in water courses or soil, at farm, regional or initiative levels, it does not progress much in assessing real impacts made on biodiversity or human health. This is because many of the effects of pesticides on biodiversity are indirect, reducing food or shelter sources or habitats for beneficial insects or breeding birds, for example, and not as a result of direct acute toxicity. Another aspect is the effects of pesticide mixtures in agricultural run-off water, which have been found to be far more damaging to health and reproductive success of amphibian populations than any of the individual pesticides alone or their additive effects (Hayes, 2005).

The need to maintain confidentiality of any individual farm's data is another obstacle to assessing the impact of schemes, yet the large amount of data collected during audits could serve to help farmers compare and improve their practice, if the data was brought together and analysed. Aggregating audit responses to some of the control points, especially those on progress requirements, would give a better picture of improvements achieved and identify areas where many farms encounter difficulties in making progress and where extra support or advice might be needed.

Farmers analysing the results of different practices and sharing information and experiences on pest management is essential for effective and sustainable implementation of IPM (Meir and Williamson, 2005). This requires investment in training and few of the schemes studied explain if or how such training is provided. 4C demonstrates the clearest commitment to training and advice for improvement, through its Support Platform services, funded by company members and public sector donors. Without targeted advice and training on IPM strategies it can be very difficult for schemes to reduce reliance on pesticides or to remove certain ones from their supply chains, if these are in common use and farmers are not confident in how to phase them out without risking crop loss or quality. This might explain why FLO decided to permit some exceptions to their prohibited pesticides lists in 2007.

Achieving real reductions in health and environmental impacts of pesticides depends not only on performance criteria within standards schemes but also on whether there are the right signals and incentives from the retail and consumer end of supply chains. An independent assessment of several certification standards performance in bananas noted that certified farms had eliminated former dangerous practices, such as discarding pesticide-impregnated plastic fruit covers in streams, but criticised the high levels of pesticide dependency remaining, with frequent aerial applications of fungicide and high volumes used per hectare (Lustig, 2004; 2005). It did recognise, however, the difficulties for individual farms to substantially change pest management practice in the context of large-scale crop monoculture and low genetic diversity, which often encourages pest and disease proliferation, and specific damaging diseases affecting fruit quality. Farms operate in a highly competitive market, with little margin for taking risks or for investing in the experimentation and learning needed to change pest management strategies. More significantly, the declining prices paid by supermarkets for food produce, as they compete to offer consumers the lowest price, undermines the ability of farms to invest in new strategies for pest management.

5.2 Conclusions

Concepts of risk management developed from experiences in industrial hygiene in a variety of occupational sectors now stress that the most effective intervention is to remove the source of risk and the least effective is personal protective equipment (Sherwood et al, 2002; 2005). In 2006, the decision-making Council of FAO recognised that pesticide poisonings remain commonplace in developing countries, despite international Conventions addressing these problems, and called for a progressive ban on highly toxic pesticides (Dinham, 2007). Standards schemes which proactively remove the most hazardous pesticides are therefore contributing best to human health protection. Fair Trade, Rainforest Alliance and Starbucks C.A.F.É. Practices are the most ambitious standards in terms of prohibiting the most acutely toxic pesticides to human health. Despite having the greatest number of control points on pesticide-related aspects, GlobalGAP makes negligible effort to removing hazardous compounds (the few it prohibits are either obsolete or no longer in common use) and has no requirements on selecting less toxic pesticides or on reducing use. On this aspect, Utz Certified diverges from its close link with GlobalGAP by prohibiting a longer list of pesticides and at least recommending least toxic options to be used. This difference is perhaps related to Utz' focus on coffee, exclusively grown in developing countries, where acute pesticide poisonings are far more frequent than in agriculture in industrialised countries, where the GlobalGAP scheme originated. Although 4C aims to be a baseline entry level scheme, it deserves praise for including some pesticide prohibitions and a medium term requirement to phase out the more hazardous ones.

There are pesticides which have proved problematic in practice, but are not in the most acutely toxic classes for mammals. Endosulfan is a case in point, where its persistence (it can remain active in soil, plants or food for weeks or months) combines with moderate toxicity and its widespread use in cotton-growing regions to represent a uniquely problematic risk profile. This is why PAN groups worldwide have called for a global ban on endosulfan, along with paraquat, a Class II herbicide, precisely because these compounds are documented to cause major health impacts. Similar conclusions on the serious problems with specific Class II pesticides were drawn by the Health Ministries in six Central American countries from an eight year poisoning surveillance programme (Rosenthal, 2005). They earmarked endosulfan, paraquat and chlorpyrifos among a region-specific 'Dirty Dozen' list proposed for regional banning. Standards schemes should take careful note of such regionally relevant evidence of direct health impacts and use the data to address specific pesticides for phase-out in their supply chains. Only FLO prohibits endosulfan (with exceptions in some crops/countries) while FLO (with one exception), RA and now Utz prohibit paraquat. None prohibit chlorpyrifos. The new FAO initiative for a progressive ban on highly toxic pesticides recognises that it is not only the most hazardous classes which are causing ill health and is developing a definition system to guide decision-makers. Standards schemes should follow these developments and integrate them into their prohibition lists.

Chronic effects on the reproductive, hormone, immune and neurological systems, pesticide effects related to cancer and genetic damage and due to combination effects from multiple exposure with other pesticides or other chemicals are mostly ignored in the schemes. Only 4C considers carcinogenicity and hormone disruption properties in its criteria lists for phase out. Chronic effects are more difficult to relate conclusively to cause and effect, especially when exposure may have occurred years before and there are many other factors which could be related to health outcomes observed. Research on smallholder potato production in Ecuador showed that many farmers exhibited reductions in neurological and motor functions due to pesticide exposure, at levels which did not result in acute poisoning symptoms (Sherwood et al., 2005). The reductions in their cognitive capacity were serious enough to affect decision-making ability and were at levels that would qualify for disability benefit in industrialised countries. It is important that workers and managers appreciate properly the possible long-term impacts of regular exposure to pesticides, even at low dose. A more precautionary approach is needed in supply chains to prevent this type of chronic harm, not only by phasing out particular pesticides implicated but also in reducing dependency on pesticides in general.

Training and awareness-raising on pesticide hazards and measures to reduce exposure are essential and all schemes are doing this to different extent. It is important that all those working on farms have a proper understanding of hazards and are actively involved in assessing risky practices and ways to reduce these. Rainforest and FLO standards stipulate the most detailed requirements on involving workers in health and safety policy design and review.

In terms of a commitment to pesticide reduction and requiring continual progress on IPM implementation, RA and C.A.F.É. Practices appear to have most to offer. Implementing IPM requires knowledge, decision-making skills and management capacity and learning through experience. For standards schemes to make a real contribution to implementing IPM systems which reduce reliance on pesticides and shift to more ecologically-based strategies for managing pests, information and experience sharing is needed within and between schemes. This should cover not only specific methods but how these are integrated into effective and flexible strategies and the costs and benefits of IPM strategies. Experience-sharing on crop-specific strategies would also provide useful information for farmers not currently in certified supply chains, particularly small and medium farmers supplying local markets. Standards schemes could also play a valuable role by joining together to influence public and private sector stakeholders to promote more IPM-friendly policies and market incentives and collaborating with research organisations.

Ultimately there are limits to what standards schemes alone can achieve in reducing pesticide problems and promoting safer pest management. This will require better government regulation and more financial commitment from supply chains and consumers to support safe and sustainable production.

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Appendix I. Documents on the requirements of each standards scheme

Rainforest Alliance SAN documents can be found at
http://www.rainforest-alliance.org/programs/agriculture/certified-crops/standards_2008.html
Main documents consulted: Sustainable Agriculture Standard. Sustainable Agriculture Network. November 2005 (the latest version of Feb. 2008 does not include any changes in relation to criteria) and detailed list of pesticide prohibitions, Nov. 2005; and updated list Jul. 2008.

Utz Certified "Good Inside" documents at:
http://www.utzcertified.org/index.php?pageID=114
Main documents consulted: Utz Certified Code of Conduct, 2006, and List of crop protection products banned by the EU, US and/or Japan, latest revision 24 Jan. 2008.

Fairtrade Labelling Organisations International documents can be found at
http://www.fairtrade.net/producer_standards.html
Main documents consulted: Generic Fairtrade Standards for Hired Labour, version 17-12-2007, and FLO Prohibited Materials List version 15-12-2007.

EurepGAP/GlobalGAP documents can be found at
http://www.globalgap.org/cms/front_content.php?idcat=48
Main documents consulted: EUREPGAP Control Points and Compliance Criteria Integrated Farm Assurance Introduction version V3.0 Mar.2007; EUREPGAP Control Points and Compliance Criteria Integrated Farm Assurance Crops Base version V3.0 Mar.2007; EUREPGAP Control Points and Compliance Criteria Integrated Farm Assurance Coffee (Green) version V3.0 Sep.2007.

Common Code for the Coffee Community (4C) documents can be found at
http://www.sustainable-coffee.net/en/code-of-conduct.htm
Main documents consulted: Common Code for the Coffee Community version 09 Sep. 2004; Plant Protection in Coffee. Recommendations for the Common Code for the Coffee Community Initiative, Jul. 2005 (available under the Library section of the 4C website as 'Pesticide Report').

Starbucks Coffee Company CAFÉ Practices documents can be found at
http://www.scscertified.com/csrpurchasing/starbucks.html
Main documents consulted: CAFÉ Practices Generic Scorecard, version V010307, 1 Mar. 2007; C.A.F.E. Practices Generic Evaluation Guidelines version 2.0, 1 Mar.2007.rohibited list expansion announcement for an additional 54 pesticides qualifying as EU bans.

Appendix II. Active Ingredients and compound groups prohibited under the different standards

N.B. This table excludes POPs list pesticides (which are banned globally) and those listed as superseded in the British Crop Protection Council's Pesticide Manual (13th edition, 2003) as these are generally no longer in global use. Only those PIC list pesticides which are not also on the POPs list are included. Pesticides in the PAN Dirty Dozen which are still on the world market (i.e. not already banned under the POPs Convention) and current PAN International campaign targets for a global ban are in **bold**.

'y' indicates that the active ingredient is prohibited in a particular scheme. 'n' indicates that there is no prohibition.
* indicates that the scheme permits specific exceptions to the prohibition.
'2010' indicates final prohibition date of 30 June 2010 for an additional 54 pesticides banned in EU to be phased out under RA July 2008 prohibited list expansion.

Pesticide a.i.	RA	Utz	FLO	G'GAP	4C	CAFE P.
1,3-dichloropropene	2010	n	n	n	n	n
2-aminobutane	2010	n	n	n	n	n
2,4,5-T	**y**	**y**	**y**	**n**	**n**	**n**
acephate	y	y	n	n	n	n
acifluorfen	2010	n	n	n	n	n
acrolein	n	n	y	n	n	y
alachlor	2010	n	n	n	n	n
aldicarb	**y**	**n**	**y**	**n**	**n**	**y***
allyl alcohol	n	n	y	n	n	y
ametryn	2010	n	n	n	n	n
amitraz	y	y	n	n	n	n
arsenic compounds	y	y	y	n	n	n
atrazine	y	n	n	n	n	n
azinphos ethyl	2010	n	y	n	n	y
azinphos methyl	2010	n	y *	n	n	y
benomyl	n	y	n	n	n	n
bensultap	2010	n	n	n	n	n
binapacryl	y	y	y	y	y	n
blasticidin	n	n	y	n	n	y
brodifacoum	n	n	y	n	n	y
bromadialone	n	n	y	n	n	y
bromethalin	n	n	y	n	n	y
bromoxynil	y	y	n	n	n	n
butocarboxim	n	n	y	n	n	y
butoxycarboxim	n	n	y	n	n	y
butylate	y	y	n	n	n	n
cadusafos	2010	n	y *	n	n	y*
calciferol	2010	n	n	n	n	n
calcium cyanide	n	n	y	n	n	y
captafol	y	y	y	y	y	n
carbaryl	2010	n	n	n	n	n
carbofuran	y (granules only) 2010 all	y	y *	n	n	y*
carbosulfan	2010	n	n	n	n	n
cartap	2010	n	n	n	n	n
chinomethionate	2010	n	n	n	n	n
chlordimeform	y	y	y	n	y	n
chlorethoxyfos	n	n	y	n	n	y
cholecalciferol	2010	n	n	n	n	n
chlorfenapyr	y	y	n	n	n	y
chlorfenvinphos	2010	n	y	n	n	y
chlormephos	2010	n	y	n	n	y
chlorobenzilate	2010	y	y	n	y	n
chlorophacinone	n	n	y	n	n	y
chlozolinate	y	y	n	n	n	n
coumafuryl	2010	n	n	n	n	n
coumatetralyl	n	n	y	n	n	y
coumaphos	n	n	y	n	n	y
crimidine	2010	n	n	n	n	n
cyanazine	2010	n	n	n	n	n
cyhalothrin	y	y	n	n	n	n
daminozide	n	y	n	n	n	n
DBCP	**y**	**y**	**y**	**n**	**n**	**n**
demeton-S-methyl	n	n	y	n	n	y
diazinon	2010	n	n	n	n	n
dichlorvos	2010	n	y *	n	n	y
dicofol	y	y	n	n (except EU 79/117 formulations)	n	n
dicrotophos	n	n	y	n	n	y
difenacoum	n	n	y	n	n	y
difethialone	n	n	y	n	n	y
dimethanamid	2010	n	n	n	n	n
dinobuton	2010	n	n	n	n	n
dinoseb & salts	y	y	y	y	y	n
dinoterb	y	y	y	n	n	y

	RA	Utz	FLO	G'GAP	4C	CAFE P.
disulfoton	n	n	y	n	n	y
diuron	2010	n	n	n	n	n
DNOC & salts	y	y	y	n	y	n
ethylene dibromide EDB	**y**	**y**	**y**	**y**	**y**	**n**
ethylene dichloride	y	y	y	y	y	n
ethylene oxide	y	y	y	y	y	n
edifenphos	n	n	y	n	n	y
endosulfan	**2010**	**n**	**y (*)**	**n**	**n**	**n**
EPN	y	y	y	n	n	y
ethiofencarb	n	n	y	n	n	y
ethion	2010	n	n	n	n	n
ethoprophos	n	n	y (*)	n	n	y*
famphur	n	n	y	n	n	y
fenamiphos	n	n	y (*)	n	n	y*
fenthion	y	y	n	n	n	n
fenitrothion	2010	n	n	n	n	n
fenpropathrin	2010	n	n	n	n	n
fentin	y	y	n	n	n	n
fentin hydroxide	y	y	n	n	n	n
fenvalerate	y	y	n	n	n	n
ferbam	y	y	n	n	n	n
flucythrinate	n	n	y	n	n	y
flurenol	2010	n	n	n	n	n
flocoumafen	n	n	y	n	n	y
fluoroacetamide	n	n	y	n	y	y
furathiocarb	2010	n	y	n	n	y
formetanate	n	n	y	n	n	y
haloxyfop-R	2010	n	n	n	n	n
HCH mixed isomers	**y**	**y**	**y**	**y**	**y**	**n**
heptenophos	n	n	y	n	n	y
hexazinone	2010	n	n	n	n	n
iminoctadine	2010	n	n	n	n	n
isoxathion	2010	n	y	n	n	y
lindane	**y**	**y**	**y**	**n**	**y**	**n**
malathion	y	n	n	n	n	n
maleic hydrazide	y	y	n	y	n	n
mecarbam	n	n	y	n	n	y
mercury compounds	y	y	y	y	y	n
methamidophos	y	y	y	n	n	y
methidathion	2010	n	y	n	n	y
methiocarb	n	n	y	n	n	y
methomyl	n	n	y*	n	n	y
methyl parathion (other than PIC formulations)	**y**	**y**	**y***	**n**	**n**	**y**
methyl bromide	y	n	n	y	n	n
metoxuron	2010	n	n	n	n	n
mevinphos	y	y	y*	n	n	y
monocrotophos	y	y	y	n	y	y
monolinuron	y	y	n	n	n	n
nicotine	n	n	y	n	n	y
nonylphenol ethoxylate	2010	y	n	n	n	n
omethoate	2010	n	y	n	n	y
oxamyl	n	n	y*	n	n	y*
oxydemeton-methyl	2010	n	y*	n	n	y
paraquat	**y**	**y**	**y***	**n**	**n**	**n**
parathion	**y**	**y**	**y***	**n**	**y**	**y**
pebulate	2010	n	n	n	n	n
pentachlorophenol	**y**	**y**	**y**	**n**	**n**	**n**
permethrin	y	y	n	n	n	n
phorate	n	n	y	n	n	y*
phosalone	2010	n	n	n	n	n
phosphamidon (other than PIC formulations)	y	y	y	n	n	y
propetamphos	n	n	y	n	n	y
propham	y	y	n	n	n	n
PMA	y	y	y	n	n	n
pyrazophos	y	y	n	n	n	n
quintozene	y	y	n	y	n	n
scilliroside	2010	n	n	n	n	n
simazine	y	n	n	n	n	n
sodium cyanide	n	n	y	n	n	y
sodium fluoroacetate	n	n	y	n	n	y
sulfotep	n	n	y	n	n	y
strychnine	2010	n	y	n	n	y
tebupirimfos	n	n	y	n	n	y
tecnazene	y	y	n	n	n	n
tefluthrin	n	n	y	n	n	y
terbufos	2010	n	y	n	n	y*
thallium sulfate	y	y	y	n	n	y
thiocyclam	2010	n	n	n	n	n
thiodicarb	2010	n	n	n	n	n
thiofanox	n	n	y	n	n	y

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thiometon	n	n	y	n	n	y
triazamate	n	y	n	n	n	n
triazophos	2010	n	y (*)	n	n	y*
trichlorfon	2010	n	n	n	n	n
tridemorph	2010	n	n	n	n	n
tri-organostannic tins	y	y	n	n	n	n
vamidothion	2010	n	y (*)	n	n	y
vinclozolin	2010	n	n	n	n	n
warfarin	n	n	y	n	n	y
zeta-cypermethrin	n	n	y	n	n	y
zinc phosphide	n	n	y	n	n	y
zineb	y	y	n	n	n	n