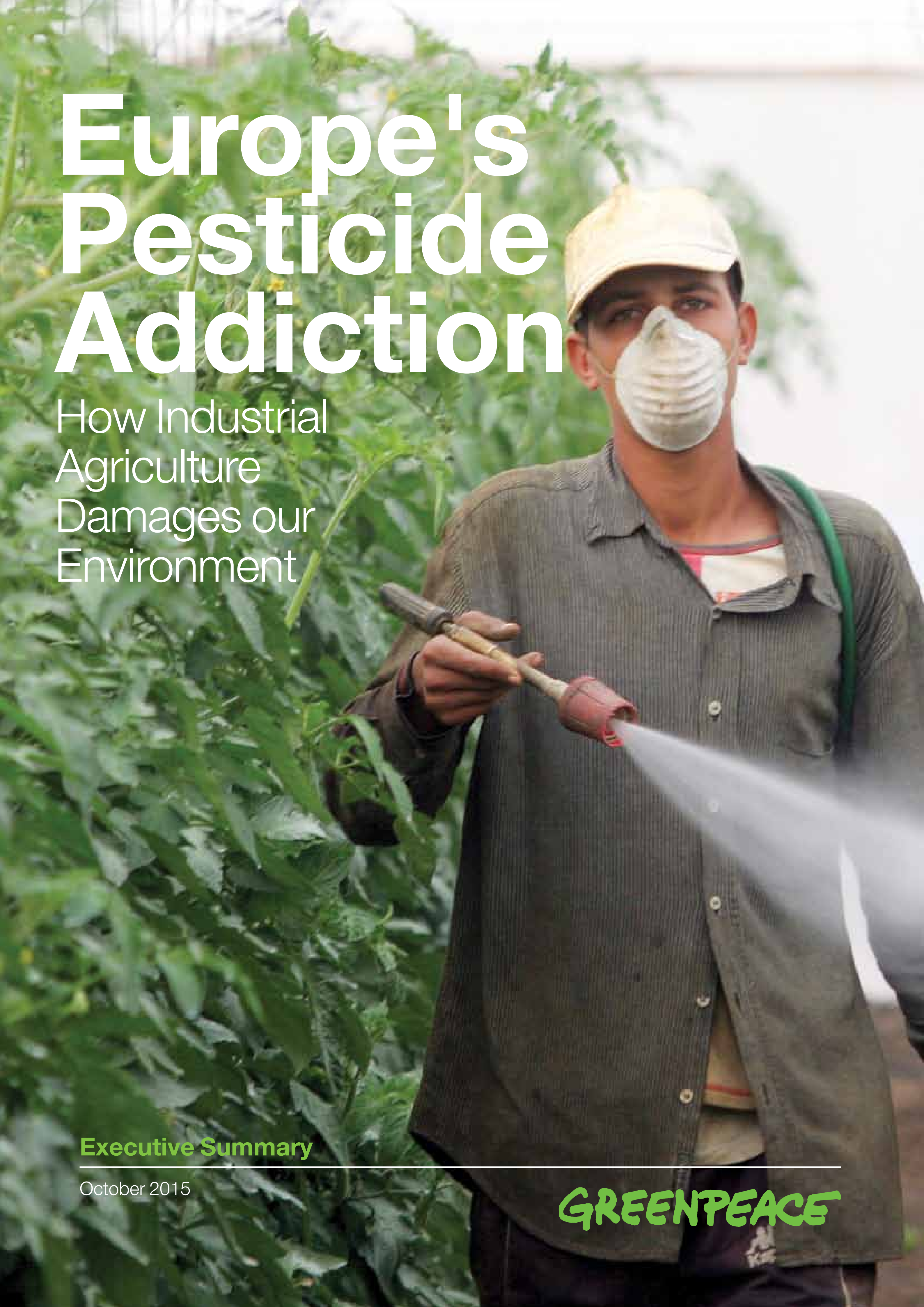


Europe's Pesticide Addiction

How Industrial Agriculture Damages our Environment

Executive Summary

October 2015

GREENPEACE

Contents

EXECUTIVE SUMMARY

© Chris Petts / Greenpeace

Why it's time to break the vicious cycle of pesticides use

For almost half a century, the global agricultural system has relied heavily on the widespread application of millions of tonnes and hundreds of types of synthetic chemical pesticides to reduce crop losses. As most farmers are now treating their crops with a variety of pesticides on a routine basis, rather than as a last resort in rare cases of heavy pest infestations, this means that chemical inputs are applied multiple times to a crop throughout the whole growing season. As a result of our dependence on chemical pesticides, and because of their persistence and pervasiveness, almost every ecosystem on earth has already been negatively impacted by these harmful chemical compounds.

"*Europe's Pesticide Addiction: How Industrial Agriculture Damages our Environment*." examines the use of synthetic chemical pesticides in Europe, the widespread and severe environmental impacts they are having - including how they are degrading some essential ecosystem services and, the urgency of tightening the regulations that are supposed to control their use.

The production, sale and use of synthetic chemical pesticides has become a multi-billion euro industry dominated by a small number of agro-chemical businesses. In 2011, three European companies, Syngenta (Switzerland), Bayer CropScience and BASF (Germany), controlled 52.5% of the global pesticide market. Three US companies, Dow AgroSciences, Monsanto and DuPont, made up the list of the top 6 pesticide companies, which together accounted for 76% of global pesticide sales.[1]

Although the global pesticide market is growing fastest in Asia and South America, driven by large increases in use in China, India, Brazil and Argentina,[2] pesticide use in the more mature European market is still forecast to rise, due to increased use in the east of the continent and an increase in the frequency of pesticide applications. The concept of the “Treatment Frequency Index” as a metric of the number of pesticide applications per crop in a given growing season has been applied to some crops in some countries. This paints an alarming picture. For example, since 2001 in Germany this index has increased in arable crops such as rapeseed, cereals and sugar beet, and in fruit crops such as apples and grapes. In 2012 the index reached a value of 32 in apple orchards,[3] meaning that on average 32 full doses of pesticides were applied to apples during a single growing season. This intensive use of pesticides raises significant questions about the impacts on single species, whole ecosystems and biodiversity, as well as the way in which these chemicals are assessed, authorised and regulated in the EU.

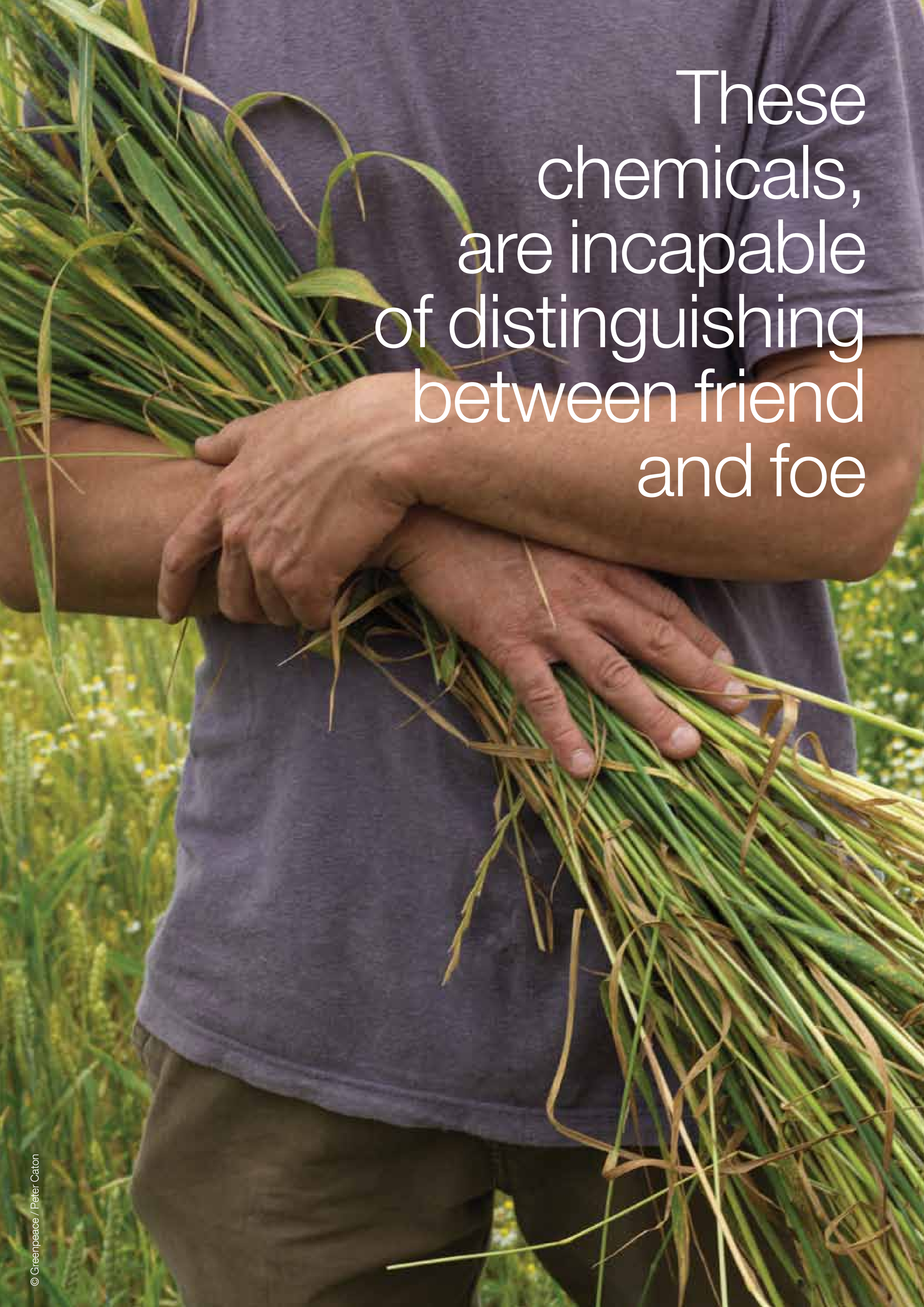
Pesticides
Missing the target

The chemicals and compounds used in pesticides can affect all organisms, and the environments that they live in and depend upon, with potentially serious ecological consequences. It has been known for a long time that the use of agro-chemicals is putting wildlife and natural environments at risk. Pesticides, in particular, are having a major impact on biodiversity losses - almost one in four (24.5%) vulnerable or endangered species in the EU are threatened by agricultural effluents, including the use of pesticides and fertilizers, like nitrates and phosphates.[4] European data also suggests a widespread decline in the diversity of wildlife species across all groups of organisms studied. For example, 27% of monitored mammal populations in Europe are in decline and even this figure could be masking a far worse trend, as the status of 33% of mammal species is unknown.[5] Highly vulnerable groups of species such as amphibians or dragonflies seem to be faring even worse. Despite the continually growing body of evidence about the serious problems being caused by chemical pesticides, no substantial policy changes have yet been made to reduce the impacts on the environment. This must be seen as a Europe-wide failure.

Pesticide effects: Acute, sub-lethal and indirect effects on individuals, populations and ecosystems

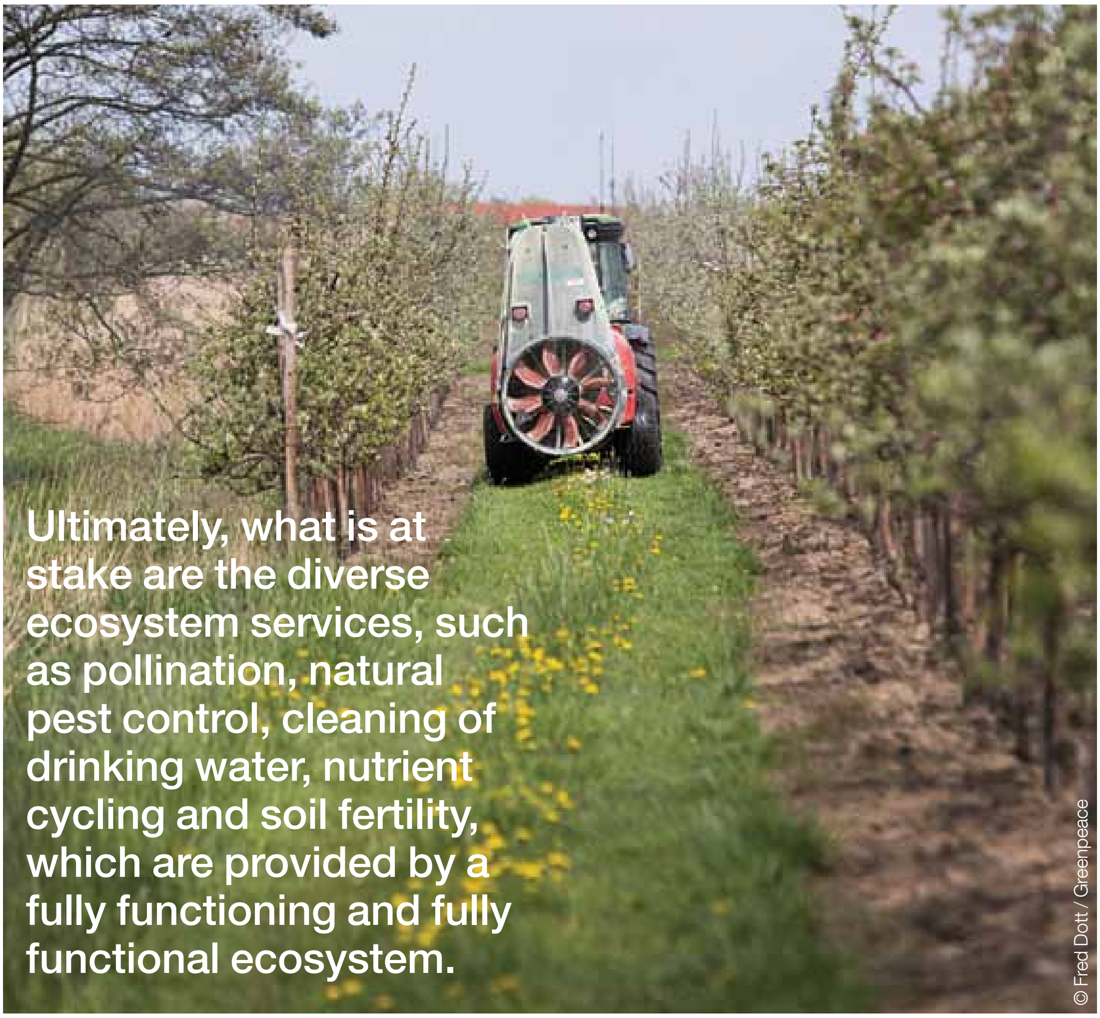
Pesticides can cause acute toxic effects in both target and non-target organisms, with direct acute mortality being the most common impact examined and reported. In some cases, the secondary toxic impacts are recognised as significant, such as in predatory birds feeding on small mammals poisoned with rodenticides, or on insects targeted with insecticides. Quite apart from these relatively obvious toxic “endpoints”, pesticides can exert a variety of subtle and complex, sometimes delayed, effects. Immunotoxicity and disruption of endocrine systems are two comparatively well-known examples of such effects where organisms are made more susceptible to disease, or where reproductive or other functions are disrupted.

The translation of these individual and sometimes subtle impacts on populations and whole ecosystems may be extremely challenging to detect and quantify, and may only be detectable over a long period of time. Attribution of impact is made more difficult by the innate complexity of ecosystems and ecosystem interactions. One relatively obvious potential impact is the reduction of food sources as a result of pesticide use. Essential components of the food web, and the parasitoids and other predators feeding on these organisms, are affected, as well as



These chemicals, are incapable of distinguishing between friend and foe other organisms feeding, in turn, upon them. A partial collapse of the food web could result from this. The complexities are well illustrated by the widely documented decline of farmland bird species over the last three decades in Europe. Direct poisoning of birds plays a role, as does the reduction in their food sources. Insectivorous bird species have been impacted by reductions of arthropod prey populations. But herbicides can also affect birds by reducing the availability of seeds as a food source. Reductions in plant biodiversity and favourable habitat have also had a considerable impact on the decline of farmland bird species.[6]

Ultimately, what is at stake are the diverse ecosystem services, such as pollination, natural pest control, cleaning of drinking water, nutrient cycling and soil fertility, which are provided by a fully functioning and fully functional ecosystem. Also at stake is the resilience of disturbed systems to climate and weather extremes. Broadly speaking, the more diverse the ecosystem - the greater its resilience to such impacts. "*Europe's Pesticide Addiction: How Industrial Agriculture Damages our Environment*." considers just a few of these ecosystem services and their immense economic importance. It must be realised, however, that any monetary valuation placed on ecosystem services is held hostage to the fact that many are in effect irreplaceable, and once they are lost then their value quickly becomes immeasurable.



Exposure to pesticides
No Escape

Pesticides can be found widely distributed in the environment, and can be transported significant distances from the areas in which they were originally applied; via the atmosphere, in water, and even in the tissues of living organisms.

Samples of ground and surface water analysed for pesticides in surveillance monitoring are regularly found to be contaminated. A recent five-year survey in Germany showed that pesticides or their metabolites had reached the ground water at 60% of the 2280 sampling points.[7] In the Netherlands, 65% of surface water samples taken from sampling stations in 2013 contained 30 or more insecticides.[8] Even more pervasive pesticide contamination has been identified in surface water, even though, in general, only a narrow spectrum of chemicals is monitored such as those specified in the EU Water Framework Directive.[9] Failings in the EU's regulatory system also mean that monitoring efforts tend to lag significantly behind the introduction of new pesticides, so problems may not be identified in a timely manner. Finally, monitoring efforts focus largely on single substances, whereas pesticides are present in the environment as mixtures of active agents, their metabolites and other chemicals.[10]
The toxicological behaviour of these mixtures has been, and remains, very poorly researched.

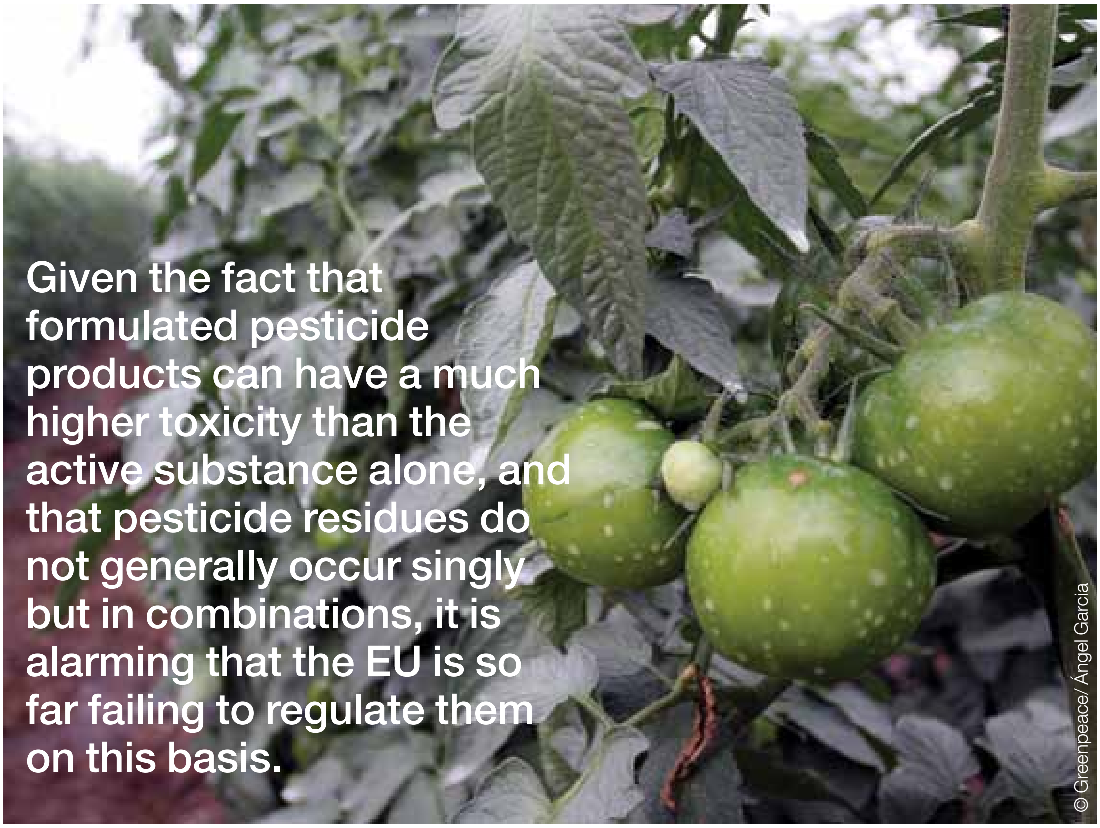
Europe is failing to effectively regulate chemical pesticides

Given the well known potential hazards associated with pesticides which are used openly in the environment, all pesticides have to go through an authorisation process before they can be used. The procedure consists of an effect assessment, which is based on toxicity tests, and an exposure assessment that relies largely on modelling of various scenarios. Mathematical modelling is used as field data are not usually available for the assessments. Pesticide risk assessments and authorisations have sometimes proven problematic or inaccurate in some way and, in some cases, adjustments have had to be made retrospectively and decisions revisited. A recent example of EU restrictions concerns some systemic insecticides of the neonicotinoid family.

On 1 December 2013, a number of uses of three neonicotinoid insecticides, thiamethoxam (produced by Syngenta), imidacloprid and clothianidin (produced by Bayer), were banned in the EU following a growing body of scientific evidence countering the initial positive assessment these systemic insecticides, instead showing serious negative impacts on honey bees and other pollinators.

A further illustration is provided by the ongoing debate around the re-authorisation of the herbicide glyphosate, and the widely differing conclusions that different institutions have arrived at - with the World Health Organisation's International Agency for Research on Cancer (IARC) classifying glyphosate as a "probable carcinogen" despite other scientific authorities giving a green light to the same chemical. This shows not only how difficult the assessment of even a single chemical can be, but also that even when a chemical has been subjected to much scrutiny, evidence may emerge much later, which requires an extensive re-think of the authorisation decision.

While improvement of the EU authorisation process for pesticides has been, and continues to be a work in progress, there still appear to be major gaps in assessment, authorisation and subsequent surveillance monitoring. Currently, almost 500 pesticide active ingredients are authorised for use in the EU. The number of commercially available pesticide



formulations, is actually much higher, since pesticides are sold as variously formulated products. Pesticide formulations usually contain not only the active substance, but also additives like solvents, surfactants and emulsifiers, designed to make them work more effectively (e.g. to assist penetration of cell membranes). Only the active ingredients are authorised, however, rather than the whole formulated product.

Given the fact that formulated pesticide products can have a much higher toxicity than the active substance alone, and that pesticide residues do not generally occur singly but in combinations, it is alarming that the EU is so far failing to regulate them. Although both the additive and synergistic effects of pesticides are described in the scientific literature, such effects are currently not taken into account in risk assessment procedures. Although there have been long running discussions about standardised methods for assessing mixtures, nothing has yet been agreed.

In addition to the EU's failure to address combinations of pesticides, some specific properties are also poorly addressed. For example, human endocrine disrupting properties have been a criterion potentially excluding chemicals from authorisation in the EU since 2009.

Not one authorisation has so far been withdrawn because of the endocrine disruption threat and, despite the very serious human health risks involved, standardised methods for quantifying such properties are still under discussion. This critical failing should be viewed against the very high probability that taking endocrine disrupting properties into account in the authorisation process would result in a number of substances being withdrawn from the market, making it more difficult for new substances to gain authorisation.

There still appear to be major gaps in assessment, authorisation and subsequent surveillance monitoring

© Thomas Einberger / Greenpeace

Setting aside the relatively new concerns around mixtures and additional modes of toxicity, even the long-used and accepted test methods applied in the authorisation process have a lot of demonstrable shortcomings. Usually, only effects on a few “standard” test organisms are tested for. The generally low susceptibility of these test organisms throws into question the degree to which they really reflect likely impacts on other individual organisms and real ecosystems. Some groups of organisms, such as amphibians, are not represented in the tests. Moreover, it is highly questionable whether the suite of lethal and sub-lethal effects used as test endpoints can ever truly represent the full range of possible impacts and some known and likely significant potential toxic endpoints are simply not evaluated at all.

The flaws extend to potentially serious conflicts of interest within the assessment process, as it is the applicant (usually the agro-chemical company) that has to perform and report on the standardised tests. Moreover, only summaries of the test results are published, not the full results, which are often only available upon request. This makes it impossible to discuss findings or to replicate the tests independently.

For many substances, particularly those which have been on the market for a longer period of time, scientific data can be found in open literature. These studies often have a markedly different scope to prescribed tests, investigate different effects and endpoints, or seek to answer more complex questions about sub-lethal and chronic effects. Additionally, they may be performed under less artificial conditions. According to EU guidelines, these studies, where they exist, have to be considered in the authorisation process, but in reality this rarely happens, because such studies are usually not considered to be relevant by either applicants or regulatory authorities.

It is also true that the wider environmental effects of pesticides are somewhat more difficult to assess than the “simple” toxicological ones. In many cases, instead of “real” data, assessments use a standard procedure involving the prediction of environmental concentrations and their effects by mathematical modelling. Studies have shown, however, that measured insecticide concentrations in the field can exceed the calculated ones by up to 78%. Therefore, under such circumstances modelling can considerably underestimate the real threat of pesticides to ecosystems. On top of this, some pesticides show unexpected “behaviours” in nature. As an example, chemicals thought to be “immobile” in soil are detected in water samples, which they were not originally expected to reach. Finally, in the EU, monitoring itself has major deficiencies. The spectrum of pesticides tested for is very narrow, and seems to focus largely on substances listed in EU regulations, namely the Water Framework Directive. A lot of substances, particularly newer pesticides like neonicotinoids, are not monitored as extensively as they should be given their widespread use. This means that pesticide regulations are currently not designed to allow a serious evaluation of the full impact of pesticides on the environment.[11]

These examples not only demonstrate the obvious failure of the EU´s pesticide approval process, they also strongly point to the serious lack of implementation of one of the fundamental principles of EU environmental law, the “Precautionary Principle”. As defined in the 1992 Rio Declaration on Environment and Development, the Precautionary Principle requires that, where there are threats of serious or irreversible damage, “lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”. In other words, protective actions must be put in place whenever risks are identified, even if there is no full scientific certainty about them. In the case of pesticides several risks have been identified, indicating the need for a more a rigorous application of the Precautionary Principle.

Jumping off the pesticide treadmill
Shifting to ecological agriculture

The over-reliance on chemical inputs, particularly of pesticides, has the potential to cause collateral damage to ecosystems precisely because they are designed to be toxic to a variety of organisms. Pesticide use, even in accordance with regulations, not only endangers single species, but ultimately can put at risk essential ecosystem services. Paradoxically, this services include natural processes of pest control.

The problems caused by the control of pest organisms through the use of chemicals are, to an extent, self-reinforcing under current agricultural practice. The farming of relatively few species and varieties, effectively in monocultures, increases their vulnerability to fungal diseases, and to insects and to weed infestations. Low diversity at all levels (species, varieties, crop rotation) supports the development of, and subsequent pressure, from all kinds of pests, which are currently controlled using pesticides.

In order to solve the problems caused by pesticide dependency, the current agricultural paradigm needs to be radically shifted towards viable, chemical-free, ecological agriculture methods. Such methods make full use of ecosystem services, including natural pest control. The development and selection of disease resistant varieties helps to reduce, and even eliminate, insect and fungal pests. Carefully designed crop rotation, as well as diversification of agricultural systems and use of di- or poly-cultures, can enhance yields markedly, and buffer

against heavy pest infestation. Protecting soils and enhancing their organic matter, thus boosting fertility, also plays a fundamental role in managing pest infestation and ensuring plant resilience. Finally, the replacement of synthetic pesticides is already being successfully carried out via biological control, which makes use of natural enemies to control pests.

The shift from a chemical-intensive agriculture system to an ecological farming model requires significant political and financial support. Only by systematically putting in place effective support mechanisms, will the majority of farmers be able to adopt ecological farming practices. Most farmers are currently involved in a system that promotes the further industrialisation and specialisation of agricultural holdings, often disregarding the serious economic and environmental impacts. This effectively prevents the long-term development of rural communities. Adequate economic incentives are essential to create the paradigm shift to ecological farming. Billions of euros of taxpayers' money currently supporting unsustainable conventional farming systems and agro-chemical R&D, should be spent instead in promoting the rapid development and uptake of ecological farming practices, with their clear benefits for the environment, but also benefits for consumers, producers and rural communities.

KEY FINDINGS

- The current destructive model of industrial agriculture depends on high levels of chemical use, particularly pesticides.
- Data shows that pesticide use continues to increase in the EU.
- Pesticides are found everywhere in the environment, they are distributed in many ways and can harm organisms far away from their point of application.
- Pesticide contamination is rarely due to a single substance. Mixtures or cocktails of pesticides are found most frequently in environmental samples.
- Acute toxicity of pesticides is often the most obvious hazardous effect, but subtle, sub-lethal effects may also take place and can include impacts on immune and endocrine responses, development, orientation, mating or foraging behaviour.
- Pesticides miss the target. They are not a precise tool targeting single pest insects but can cause severe damage to other, often 'beneficial', organisms.
- Pesticides cause biodiversity losses reducing populations of several organisms in agricultural ecosystems, even of animals on high trophic levels, such as birds of prey.
- Pesticides also have serious indirect effects on ecosystems, including the disruption of food webs and the destruction of habitats, and can already be linked to the decline of farmland bird species and arthropod populations, which many organisms feed upon.
- Pesticides can significantly affect fundamental "ecosystem services" like pollination, natural pest control, cleaning of drinking water, nutrient cycling and soil fertility.
- The EU is failing to control pesticides:
    - "Cocktail effects" of mixtures of pesticides are not routinely assessed;
    - Adverse effects, particularly sub-lethal ones, are too often overlooked, even on important pollinators like honey bees;
    - Only the active ingredients of pesticides are assessed, not the formulations applied in practice;
    - Endocrine disruption is not adequately assessed, despite being a criterion for the rejection of pesticide authorisations since 2009;
    - Assessment of sub-lethal effects is inadequate;
    - The authorisation process is not transparent and is dominated by industry information, particularly in relation to the studies used to inform it;
    - Organisms used in standard tests are often "robust" ones, thus not representative of naturally occurring organisms;
    - Independent studies are generally not taken into account, although they often find subtle impacts on certain species or the wider environment;
    - Modelling of pesticide contamination in the environment underestimates the real concentration of pesticides, even though it is integral to the authorisation process;
    - For many pesticides environmental monitoring is not currently foreseen.
- Powerful political and financial support is urgently required to support the shift from the current destructive chemical-intensive industrial agriculture system to ecological farming.

Recommendations

A wide body of empirical scientific research, already provides irrefutable evidence of the environmental impacts that pesticides cause. This indicates once more the urgent need to move away from the current chemical dependency of industrial agriculture. The widespread presence of pesticide residues in ecosystems, with its both, known and as yet unknown consequences, makes it obvious that the only way to avoid the risks and dangers posed by pesticides use is to phase out their use in agriculture. Non-chemical alternatives to pest management are already available to farmers but need the necessary political and financial support to be mainstreamed.
Only by reducing pesticide use and ultimately converting farming systems to ecological farming practices will it be possible to address the ecological and economic problems that agriculture currently faces.

In order to drive the needed change the following measures must be put in place as a priority:

- **Breaking the vicious circle imposed by pesticide use**. Focusing on functional agro-biodiversity is a key element. Choosing resistant varieties adapted to local conditions, setting up serious crop rotation schemes, diversifying agricultural systems at field and landscape level, improving soil management methods and implementing biological control of pests can replace pesticide use in agriculture.

- **Ensuring proper implementation of the directive on the sustainable use of pesticides**. As required by EU law, member states should put in place concrete measures and targets leading to a substantial reduction in pesticide use.

- **Overhauling regulatory controls for pesticide risk assessment**. In particular, investigating and monitoring the effects that the exposure to cocktails of chemicals can have on human health and the environment. The specific pesticide formulations used in the field should also be subject to testing and rigorous scientific assessment rather than the active ingredients alone. In addition, all available independent scientific literature should be taken into account as part of risk assessment processes, and all studies and data used in the assessment should be made publicly available. Once an authorisation has been granted, if scientific evidence emerges bringing additional information that could put into question the conclusions of the risk assessment process a re-evaluation of the active substance and the formulations should immediately take place.

- **Shifting towards ecological farming needs political and financial support**. Public research must be re-focused on ecological farming practices, and plant breeding should address the needs of ecological farmers, by delivering robust and locally adapted varieties, in participation with farmers.

- **Abolishing subsidies that promote the maintenance and upscaling of industrial agriculture practices**. Billions of euros of taxpayers' money is being poured into a broken system that continues to cause serious environmental and economic impacts. Public subsidies must instead be targeted to farmers to support the implementation of environmentally friendly farming methods. This would mean radically reforming the EU's Common Agricultural Policy (CAP) by phasing out subsidies promoting environmentally destructive practices, and making rural development subsidies conditional on the development and implementation of ecological farming methods.

- **Phasing-out synthetic chemical pesticides by prioritising chemicals with particularly hazardous properties**. This would mean banning pesticides that have bee-harming properties, are carcinogenic, mutagenic and toxic to reproduction, or which interfere with the hormone system (endocrine disrupting substances) as well as neurotoxic substances.

- **Introducing fiscal measures discouraging the use of pesticides and promoting the implementation of ecological farming practices**.

Endnotes

[1] "Putting the Cartel before the Horse: Who Will Control Agricultural Inputs, 2013?" - ETC Group, September, 2013, p.10. http://www.etcgroup.org/sites/www.etcgroup.org/files/CartelBeforeHorse11Sep2013.pdf; accessed 23.9.2015.

[2] Global Pesticides Industry 2012-2017: Trend, Profit, and Forecast Analysis, April 2012, Lucintel. http://www.lucintel.com/reports/chemical_composites/global_pesticides_industry_2012_2017_trends_foreacast_april_2012.aspx.; accessed 23.9.2015.

[3] Chapter 2. Pesticide use in Europe.

[4] IUCN 2015: database-search on 9th of october 2015 (http://www.iucnredlist.org/search/link/56178c5c-dbe482f8)

[5] Chapter 2., Figure 2. Population trends of European mammals (EU 2015a).

[6] Chapter 4. Pesticides and birds.

[7] Chapter 3. Pesticides in the environment.

[8] http://www.pesticidesatlas.nl/; accessed 8.9.2015.

[9] Chapter 5. Pesticides and aquatic organisms.

[10] Chapter 3. Pesticides in the environment.

[11] Chapter 5. Pesticides and aquatic organisms.

GREENPEACE

Greenpeace is an independent global campaigning organisation that acts to change attitudes and behaviour, to protect and conserve the environment and to promote peace.

Executive summary written by:
Dirk Zimmermann

Written by:
Wolfgang Reuter, ForCare
Lars Neumeister

Edited by:
Martin Baker

Art Direction/Design by:
Atomodesign.nl

Front cover image
© Greenpeace / Ángel Garcia

Published October 2015 by
Greenpeace Germany e.V.
Hongkongstr. 10
20457 Hamburg
Presse@greenpeace.de

greenpeace.de