PESTICIDE IMPACTS AND ALTERNATIVES

A SCIENTIFIC PERSPECTIVE

Kirsten Thompson
Greenpeace Research Laboratories,
University of Exeter, UK

GREENPEACE
RESEARCH LABORATORIES

GREENPEACE RESEARCH LABORATORIES

- **Six full-time scientists with over 100 person years of combined experience**
- **Diverse expertise**
- **Support and advice to campaigns: sampling, experimental design**
- **Preparation of technical reports and peer reviewed literature**

GREENPEACE
RESEARCH LABORATORIES

www.greenpeace.to

INDUSTRIAL AGRICULTURE

- Data on total pesticide usage difficult to obtain
- However, at least 220,000 tonnes of active ingredients used per year in the EU (Eurostat, 2007)
- 2.1 kg active ingredient per hectare

PESTICIDES IN FOOD

Tea – 94% samples with at least one pesticide, 59% with more than 10 pesticides, 59% over EU-MRL (Maximum Residue Limit), one sample contained 20 different pesticides (Greenpeace India 2014)

Review of scientific literature investigating pesticides in vegetables (since 2007):

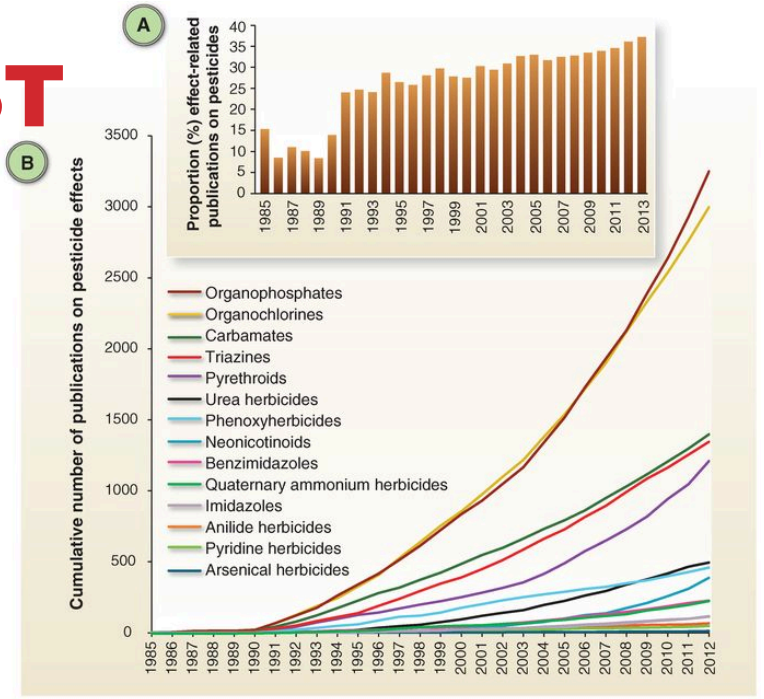
- **Consistent evidence for MULTIPLE residues present in food as mixtures, in some cases at levels 50% above EU-MRLs**
- **Components of mixtures are capable of interacting synergistically - risk assessment impossible – millions of combinations**
- **Consequences of these pesticides acting together are unknown (Reffstrup et al. 2010)**

Greenpeace India (2014) Trouble Brewing: Pesticide residues from tea samples in India.

Reffstrup et al. (2010) Regulatory Toxicology and Pharmacology

INCREASED RESEARCH INTEREST

- **Scientific community more aware of risks**
- **Increase in research indicates growing concern over impacts**
- **Little uncertainty that the impacts are wide and varied**



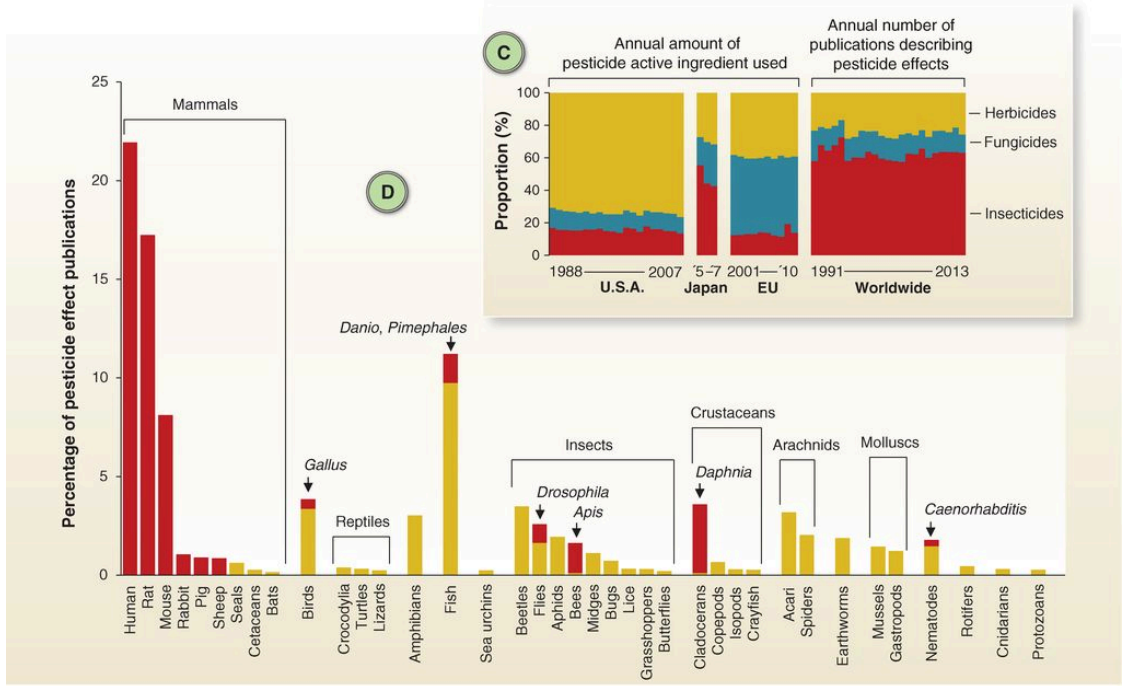


Fig 1. Trends in research on pesticide effects and pesticide use. Steadily increasing proportion of effect-related research among publications on pesticides in the past 28 years.
(Source: Köhler & Triebskorn (2013) Science)

PESTICIDES IN ENVIRONMENT

Environmental persistence and water solubility of pesticides leads to large scale contamination of soils, ground and surface water and plant tissues from both treated crops and non-treated plants e.g. neonicotinoids (Van der Sluijs et al. 2014)

Direct and indirect (sub-lethal effects):

- **Mammals (Law et al. 2014; Carpenter et al. 2014)**
- **Amphibians (Wagner et al. 2014)**
- **Birds (Hallman et al. 2014; Goulson 2014)**

Current agricultural system is no longer viable

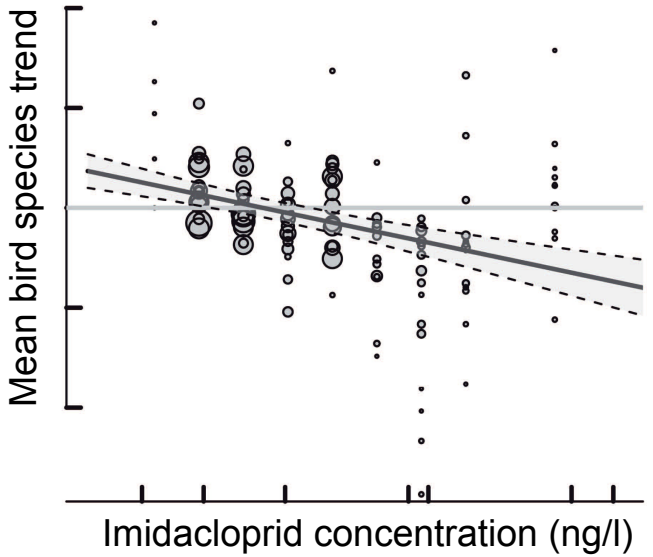


Fig 2. Diversity of bird species with increasing imidacloprid concentrations (Source: Hallmann et al. 2014)

Hallmann et al. (2014) Nature; Goulson (2014) Nature; Law et al. (2014) Marine Pollution Bulletin; Carpenter et al. (2014) Ecotoxicology and Environmental Safety; Wagner et al. (2014) Biological Conservation; Van der Sluijs et al. 2014 Environmental Science and Pollution Research.

BEES

- **53 different pesticides found in bee pollen (Johnston et al. 2014)**

- **Declines in bees in global agroecosystems – pollinator services (Kennedy et al. 2013)**

Significant increases in bee abundance diversity in organic farms relative to conventional farms

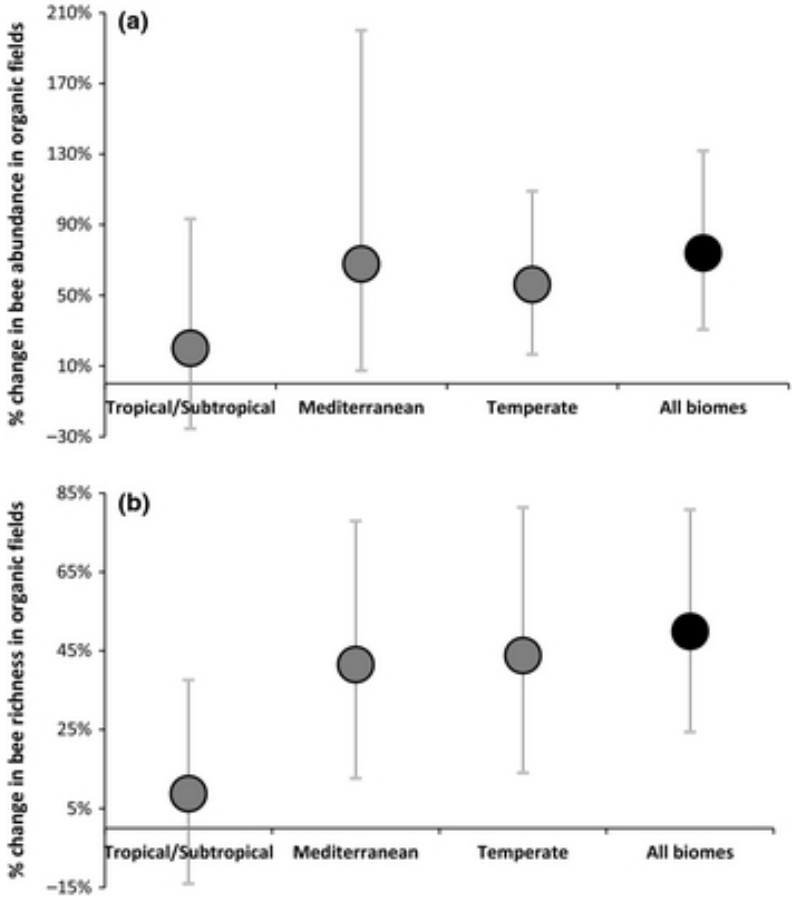


Fig 3. Percent change in wild bee abundance (a) and wild bee richness (b) in organic fields relative to conventional fields for tropical and subtropical studies (*n* = 10), Mediterranean studies (*n* = 8), temperate studies (*n* = 21) and overall (*n* = 39). (Source: Kennedy et al. 2013)

Johnston et al. (2014) The Bees Burden, Greenpeace Technical Report; Kennedy et al. (2013) Ecology Letters.

BEES

The facts:

- **31 of 68 species of bumblebees in Europe are in decline (IUCN BBSG 2013)**
- **Six of 16 species in the UK have declined considerably, with one species now extinct (Potts et al. 2010)**
- **25-68% of wild bee species endangered across various habitats of Central Europe**
- **Estimated 25% loss of managed honey bee colonies between 1985 and 2005**

IUCN Bumble Bee Specialist Group (2013); Potts et al. (2010) Trends in Ecology and Evolution

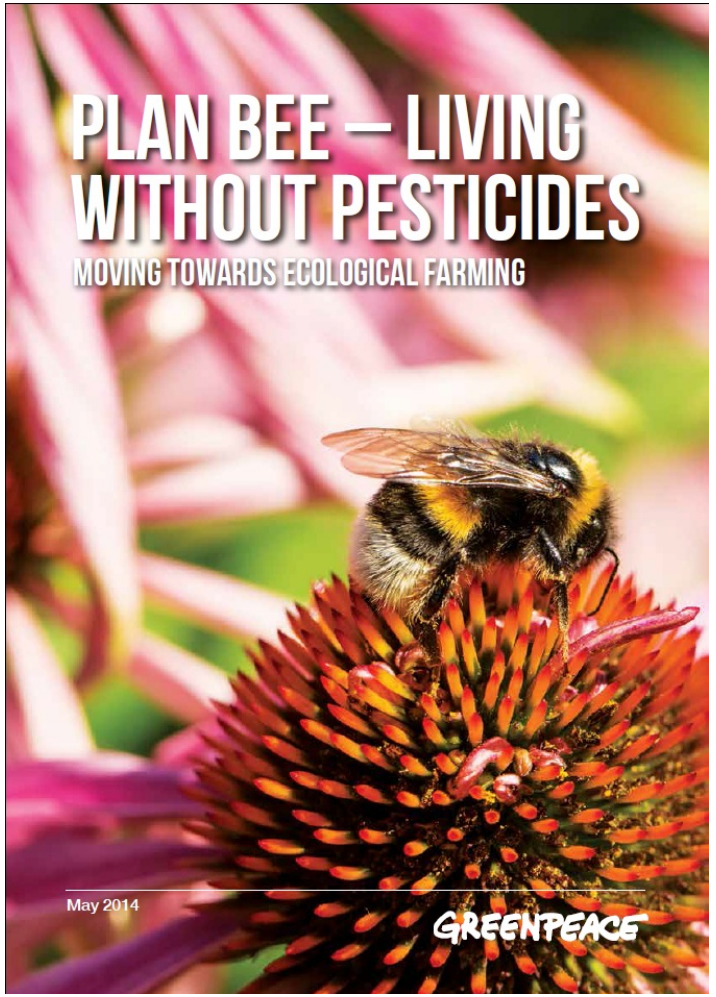
PLAN BEE – LIVING WITHOUT PESTICIDES

Allsopp et al. (2014) reviewed > 25 years literature on causes and consequences of pollinator decline.

The causes – multiple factors:

- **Spread of disease and parasites**
- **Changes in climate and weather**
- **Increased use of pesticides (including residues brought back to the hive)**
- **Habitat loss**

Highlights the need for ecological farming



Allsopp, M., Tirado, R., Johnston, P., Santillo, D. & Lemmens, P. (2014) Plan Bee – Living without pesticides: Moving towards ecological farming. Erwood, S. [Ed.], Publ. Greenpeace International, May 2014: 80 pp.

PRINCIPLES OF ECOLOGICAL AGRICULTURE

1. Ecological farming is feasible, practical and scalable (Pretty et al. 2011),
    - Develop a mosaic of land use and semi-natural habitat
    - Habitat for pollinators – ecological pest control
    - Crop rotation, cover crops

2. Use established techniques in smarter ways,
    - Intensification in terms of landscape richness, heterogeneity and cropping density

Pretty et al. (2011) International Journal of Agricultural Sustainability

PRINCIPLES OF ECOLOGICAL AGRICULTURE

3. Benefits to quality, resilience and yields of crops

- **Develop biophysical resilience – boosting soil nutrients, water retention (Okeyo et al. 2014; Palm et al. 2014)**
- **Naturally resistant varieties of crops and greater diversity crops (Webber et al. 2014)**
- **Increase yields (Pretty et al. 2006)**
- **Increased resilience to climate fluctuations (Pretty et al. 2011; Sinclair et al. 2014; Tittonell 2014)**
- **Adaptive practices – changing cropping systems, sowing dates (Waha et al. 2013)**

4. Build stronger local supplies of food and increase farmer knowledge

Okeyo et al. (2014) Agricultural Water Management; Pretty et al. (2006) Environmental Science and Technology; Pretty et al. (2011) International Journal of Agricultural Sustainability; Sinclair et al. (2014) Agriculture and Human Values; Tittonell (2014) Agricultural Systems; Waha et al. (2013) Global Environmental Change; Webber et al. (2014) Agricultural Systems.

CONCLUSIONS – WAYS FORWARD

Emerging evidence from many organisations e.g. UNEP, World Bank and the academic community to suggest that changing our approach to farming is vital.

Agron. Sustain. Dev. (2014) 34:1–20
DOI 10.1007/s13593-013-0180-7

REVIEW ARTICLE

Agroecological practices for sustainable agriculture. A review

Alexander Wezel · Marion Casagrande · Florian Celette · Jean-François Vian · Aurélie Ferrer · Joséphine Peigné

Accepted: 6 September 2013 / Published online: 27 September 2013

Abstract The forecasted 9.1 billion population in 2050 will require an increase in food production for an additional two billion people. There is thus an active debate on new farming practices that could produce more food in a sustainable way

Contents
1. Introduction. . . . . .
2. Definition of agroecological cropping practices a
alytical framework

Journal of Applied Ecology 2014, **51**, 746–755 doi: 10.1111/1365-2664.122

REVIEW

Land-use intensity and the effects of organic farming on biodiversity: a hierarchical meta-analysis

Sean L. Tuck[1]*, Camilla Winqvist[2], Flávia Mota[3], Johan Ahnström[2], Janne Bengtsson[2]†

ersity of Oxford, Oxford OX1 3RB, UK; [2]Section for Landscape and Soil Ecolog -44, Uppsala S-750 07, Sweden; and [3]Institute of Evolutionary Biology and Zurich, Zurich 8057, Switzerland

farming to biodiversity in agricultural landscapes continue to be g the importance of precisely quantifying the effect of organic vs.

ted hierarchical meta-analysis of studies that compared biodiversity tional farming methods, measured as species richness. We calcu- observations garnered from 94 studies, and for each study, we d measures reflecting land-use intensity. We investigated the stabil- ime, publication bias due to the 'file drawer' problem, and consider ure is representative of global organic farming patterns.

Policy Analysis

Resource-Conserving Agriculture Increases Yields in Developing Countries

J. N. PRETTY,*,† A. D. NOBLE,‡ D. BOSSIO,§ J. DIXON,∥ R. E. HINE,† F. W. T. PENNING DE VRIES,⊥ AND J. I. L. MORISON†

Department of Biological Sciences and Centre for Environment and Society, University of Essex, Wivenhoe Park, Colchester CO4 3SQ, U.K., International Water Management Institute (IWMI), P.O. Box 1025, Kasetsart University, Bangkok 10903, Thailand, International Water Management Institute (IWMI), P.O. Box 2075, Colombo, Sri Lanka, Impact Targeting and Assessment Program, CIMMYT, Apdo. Postal 6-641, 06600 Mexico, Mexico, and International Project Office for Monsoon Asia Integrated Regional Study, Institute for Atmospheric Sciences, Chinese Academy of Sciences, P.O. Box 9804, Beijing, China

Despite great recent progress, hunger and poverty remain

the types of in
(*1*–*4*). Great te
has not been r
poverty in deve

However, m
demonstrating
greatly improv
projects in 57 co
since the early t
both water use
reduced pestic
prospects of res
adverse effects
important envi
change mitigat

In the past 4
grown by 17%,
2003 of 2780 kca
hungry are sma
eat. Yet consun
2200 kcal day^{-1}
coming decade
demand for foo
purchasing po
people to adopt

SOLUTIONS

1. Shift away from chemical-intensive farming models to ecological agriculture practices
2. Boost biodiversity by conserving natural habitats and re-establish semi-natural habitats
3. Consistent and coordinated policies and actions on a global level
4. Research and development of methods
5. Training and support
6. Financial incentives for companies and farmers

GREENPEACE
RESEARCH LABORATORIES