Dialogos

UNACOH
"Health for All & By All"

OUH

Pesticide poisonings in low- and middle-income countries

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ICOEPH
Work - Enviroment - Health

नेपाल जनस्वास्थ्य प्रतिष्ठान
PREVENTION PROMOTION PROTECTION
NEPAL PUBLIC HEALTH FOUNDATION
ESTD : 2010

PLAGBOL
Salud, Agricultura y Medio Ambiente

Pesticides are poisons most often damaging the nervous system

- 2-400.000 deaths of acute pesticide poisoning/year, here of 25.000 occupational
- 3-4.000.000 severe cases of acute pesticide intoxication/year needing hospital care
- An estimated 20-25 millions of less severe acute pp cases among farmers

- More than 95% of poisonings occur in low and middle income countries!

The global distribution of acute unintentional pesticide poisoning: Estimations based on a systematic review. Boedeker et al, 2020

- 141 countries were covered,
- 740,000 annual cases of UAPP were reported by the extracted publications
- 7446 fatalities and 733,921 non-fatal cases
- **Estimate 385 million cases of UAPP** occur annually world-wide including **around 11,000 occupational fatalities**.
- Based on a worldwide farming population of approximately 860 million this means that about 44% of farmers are poisoned by pesticides every year.
- Greatest estimated number of cases is in southern Asia, south-eastern Asia and east Africa

The use of self-reported symptoms as a proxy for acute organophosphate poisoning after exposure to chlorpyrifos 50% plus cypermethrin 5% among Nepali farmers: a randomized, double-blind, placebo-controlled, crossover study

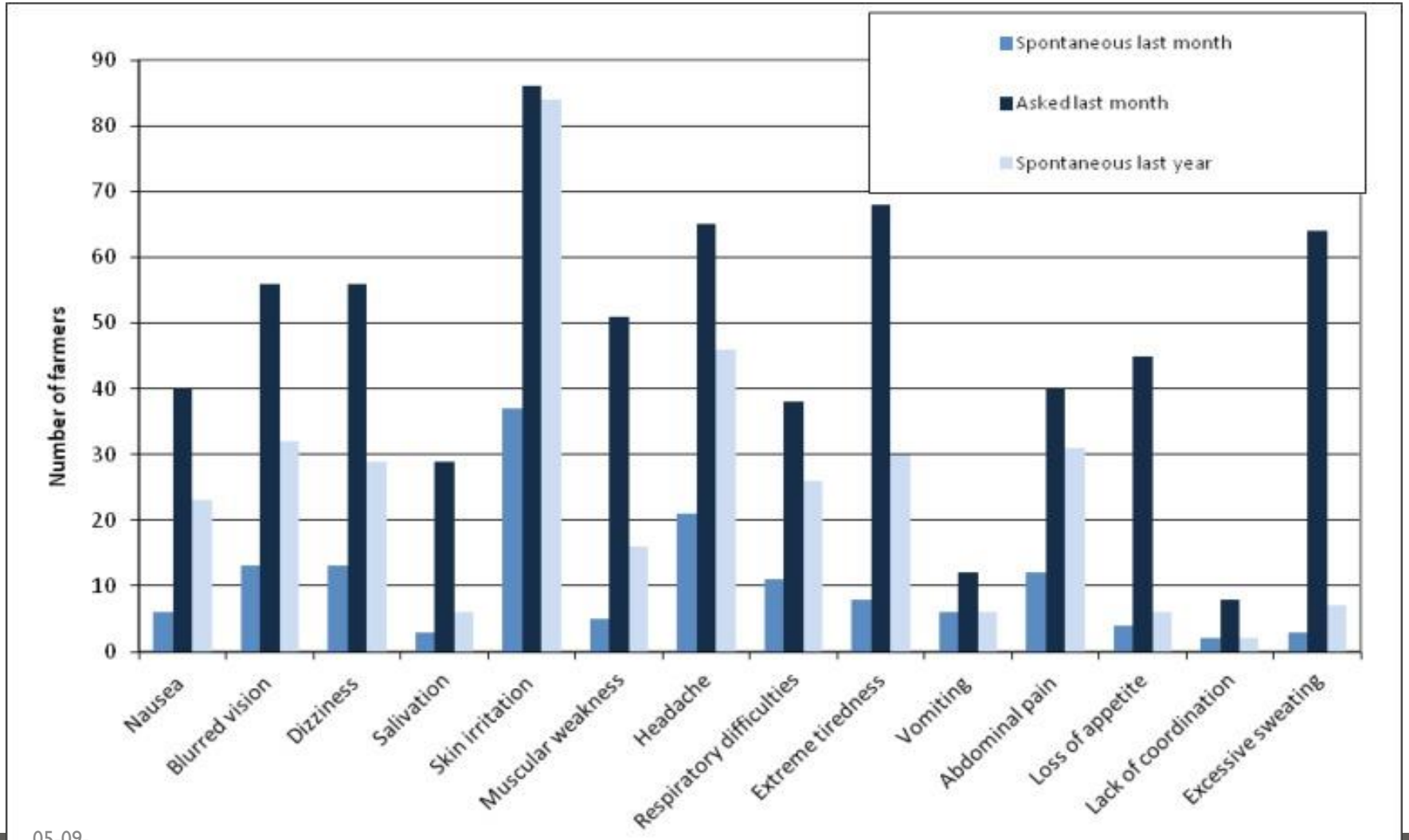
Environmental Health (2016) 15:122 Dea Haagensen Kofod et al

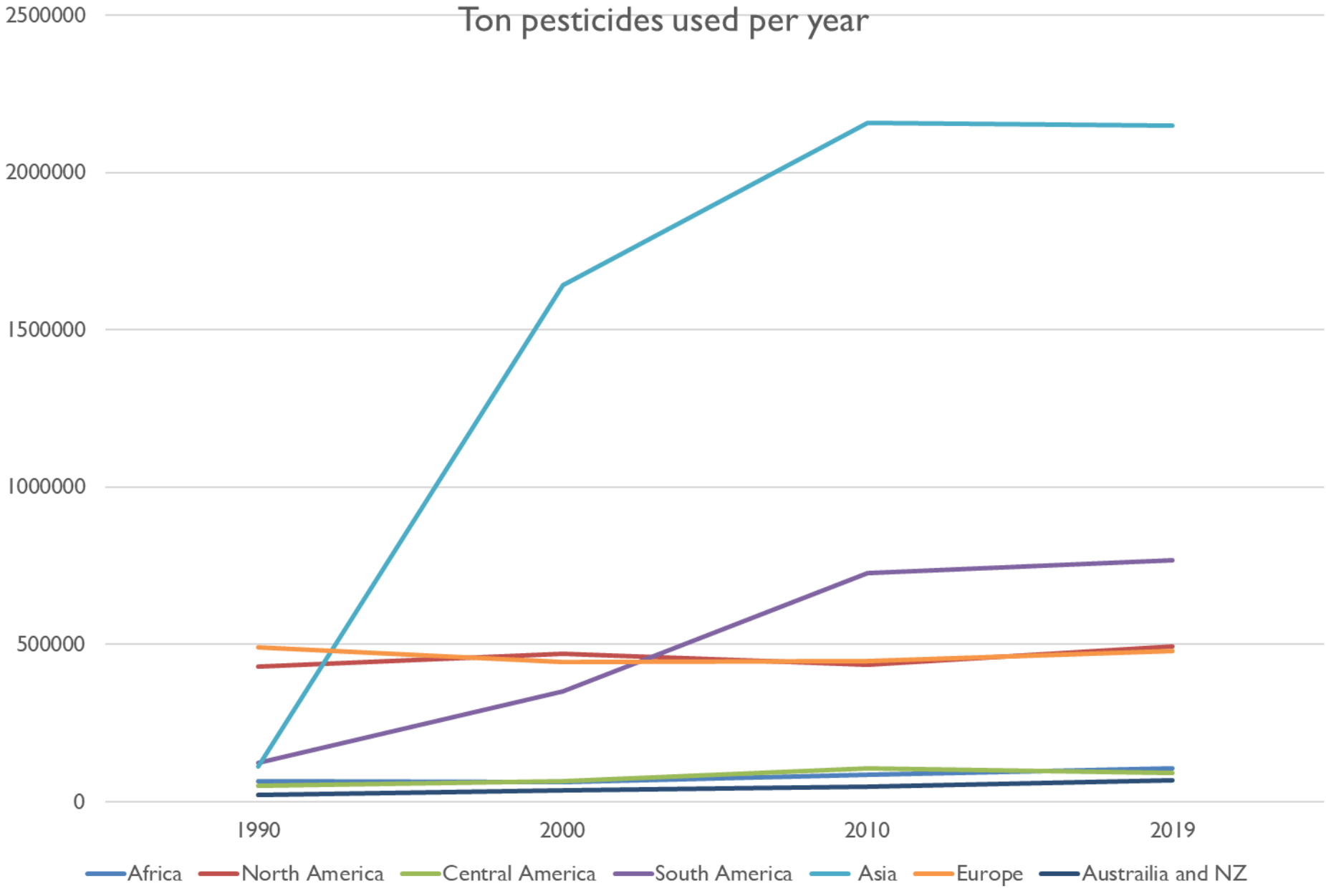
- 2 hours spraying time with OP and placebo
- A high percentage of the farmers reported having one or more symptoms both at baseline and at follow up in the **organophosphate spray session** (baseline 47.6%, follow up 45.2%) and **placebo spray** session (baseline 35.7%, follow up 50.0%)
- 14.3% of the farmers reported three or more symptoms after the organophosphate spray session as well as after the placebo spray session.

Prevalence of acute pesticide poisonings and ChE depression among farmers in other surveys

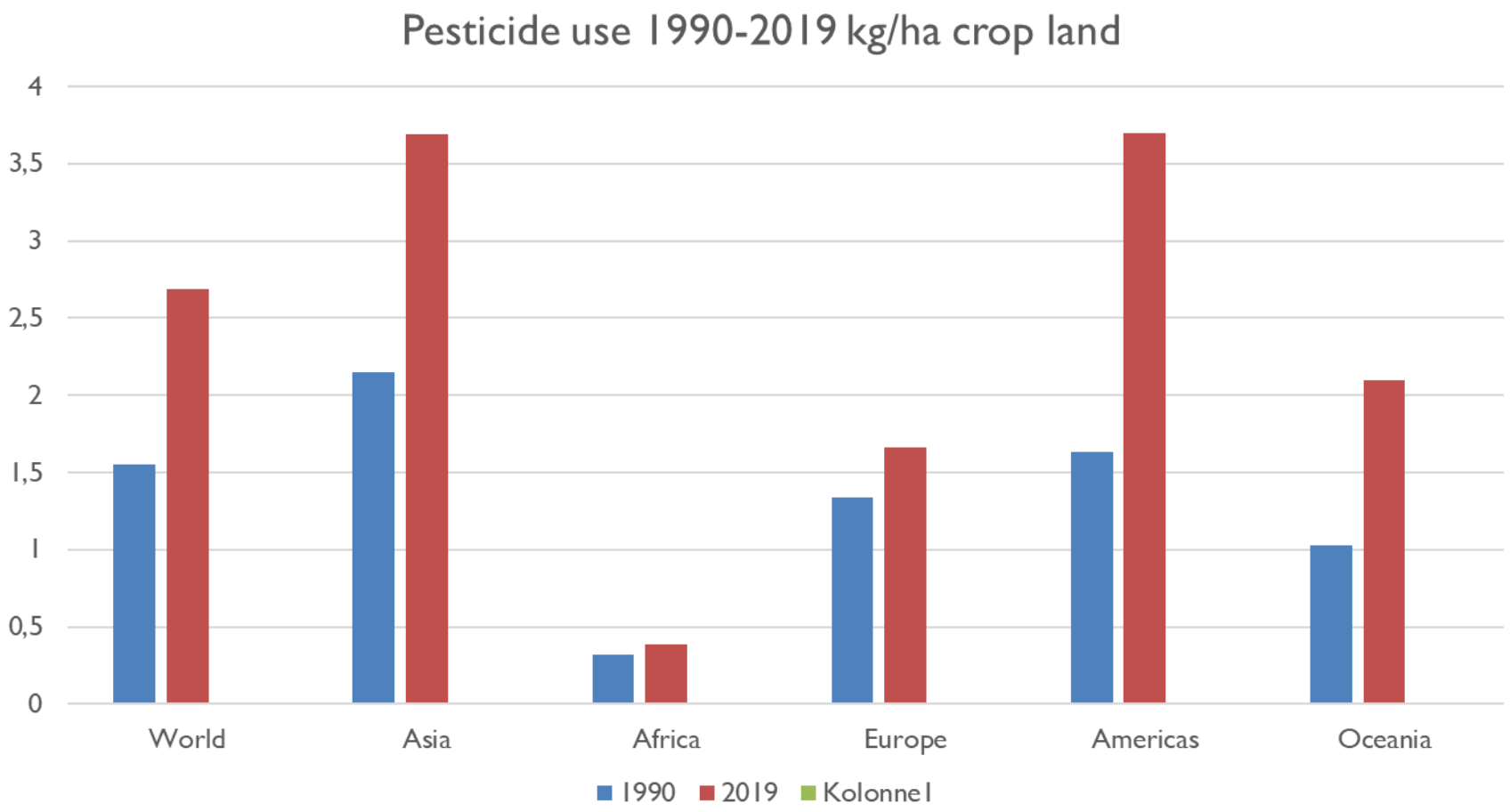
Author, year, country	Self-reported symptoms and observed signs of APP among farmers	Affection of cholinesterase enzyme activity in blood
Mancini, 2005 India,	83.6% of spraying sessions ≥1 symptom 10% of the spraying sessions followed by ≥3 symptoms	.
Ohayo-Mitoko 2000, Kenya	40.1% 'lifetime prevalence' among farmers having ≥1 symptom of which 25.4% sought medical treatment	AChE lower among exposed farmers vs controls 41% of farmers had ≥30% AChE inhibition from low to high exposure period
Tomenson 2009, Twenty-four countries	6.4 % '12 months prevalence' of serious to moderate APPs in the need for medical assistance 19.8 % '12 months prevalence' of minor symptoms of APP Highest prevalence seen in middle- and low- income countries	
Dasgupta, 2007 Vietnam,	88% prevalence of self-reported APP after 1252 spraying sessions with a mean of 4 symptoms	AChE depression among 35 % of farmers

Pesticide knowledge, practice and attitude and how it affects the health of small-scale farmers in Uganda: a cross-sectional study - Afr Health Sci . 2014 Jun;14(2):420-33 - Anna H Oesterlund et al




Ton pesticides used per year
2500000
2000000
1500000
1000000
500000
0
1990
2000
2010
2019
Africa
North America
Central America
South America
Asia
Europe
Austrailia and NZ

FAOSTAT


Pesticide use 1990-2019 kg/ha crop land
4
3,5
3
2,5
2
1,5
1
0,5
0
World
Asia
Africa
Europe
Americas
Oceania
1990
2019
Kolonne1

Reasons for poisoning

Reasons for poisoning

Occupational pesticide intoxications among farmers in Bolivia: A cross-sectional study.

Environmental Health: A Global Access Science Source 2006, 5:10
doi:10.1186/1476-069X-5-10

Table 1 - Classification of pesticides used by farmers, the ten most used active ingredients and their characteristics (n=171)

Active Ingredient	Used by percent of farmers	Toxicological classes*	Chemical class	Classification by main use
Methamidophos	69 %	Ib	Organophosphate	Insecticide
Sulphur	40 %	U		Fungicide
Propenophos	34 %	II	Organophosphate	Insecticide
Cypermethrim	26 %	II	Pyretroide	Insecticide
Spinosad	25 %	U		Insecticide
Propineb	25 %	U		Herbicide
Parathion	23 %	Ia	Organophosphate	Insecticide
Dimethoate	16 %	II	Organophosphate	Insecticide
Permethrin	15 %	II	Pyretroide	Insecticide
Lambda cyhalotrin	11 %	II	Pyretroide	Insecticide

* Ia extremely hazardous, Ib highly hazardous, II moderately hazardous, III slightly hazardous, U active ingredient unlikely to present any harm in normal use, O obsolete (WHO classification).

Occupational pesticide intoxications among farmers in Bolivia: A cross-sectional study.

Environmental Health: A Global Access Science Source 2006, 5:10
Jørs E et al

- 50% of farmers have experienced one or more symptoms of intoxication after spraying operations within past year
- Farmers knew about intoxications in their village within the last 5 years:

  76% suicides

  26% occupational

  12% accidental
- Hospital registers: >50% of intoxications in a year due to pesticides, of these 92% are suicidal attempts

Characteristics of Pesticide Poisoning in Rural and Urban Settings in Uganda

Environ Health Insights . 2017 Jun 5;11
Bastian Pedersen et al

- In the urban setting, pesticides were the most prevalent single poison responsible for intoxications (N = 212 [28.8%]).
- Self-harm constituted a significantly higher proportion of the total number of poisonings in urban (63.3%) compared with rural areas (25.6%) where unintentional poisonings prevailed.
- Unintentional cases were almost the only ones seen below the age of 10, whereas self-harm dominated among adolescents and young persons from 10 to 29 years of age.
- Organophosphorus insecticides accounted for 73.0% of the poisonings.

Pesticides kept unlocked on shelf in kitchen

Reasons for poisoning

Reasons poisoning

Surveys on protective measures

Author, publishing year, country, study population	Reads instruction for use	Uses boots (shoes)	Uses gloves	Uses mask or face scarf	Washes body after spraying	Changes clothes after spraying
Matthews, 2008, 26 countries 8500 farmers		54 %	50 %	29 %		
Kim J-H, 2013, Korea 1958 male farmworkers	86 %	85 %	51 %	47 %	94 %	94 %
Hurtig AK, 2003, Ecuador 111farmworkers		99 %	5 %	7 %	89 %	76 %
Nordin RB, 2002, Malaysia 496 farmworkers		67 %	67 %	54 %	98 %	71 %
Yassin MM, 2002, Palestine 189 farmworkers		15 %	20 %	22 %	54 %	
Lekei EE, 2014, Tanzania 121 coffee and vegetable farmers	71 %	38 %	<10 %	<10 %		
Neupane D, 2014, Nepal 90 rice and vegetable farmers		<10 %	<10 %	46 %	70 %	84 %
Jensen HK, 2010, Cambodia 89 vegetable farmers	46 %	3 %	18 %	49 %	98 %	96 %

Is prevention of acute pesticide poisoning effective and efficient, with Locally adapted Personal Protective Equipment? A randomized crossover study among farmers in Chitwan, Nepal

Med Lav 2016; 107, 4: 271-283

Anshu Varma et al

- 45 male farmers from Chitwan, Nepal, were randomly allocated to work as usual applying organophosphate pesticides wearing Locally Adapted Personal Protective Equipment or Daily Practice Clothing.

For outer body protection the farmer wore:

- a bamboo hat,
- face shield fixed with elastic band,
- rainproof cape, rubber boots, latex gloves

The influence of tomato processing on residues of organochlorine and organophosphate insecticides and their associated dietary risk.

Reiler E et al
Sci Total Environ. 2015 Sep 15;527-528:262-9

- Only 3.7% of tomato samples were without any detectable pesticide residues
- 14.8% complied with EU MRLs (maximum residue level), and 38.9% complied with local MRLs.
- Acute risk was found to be minimal
- Chronic risk assessment, acceptable daily intake (ADI) exceedances, with potential of causing chronic pesticide poisoning.
- Peeling, washing, storage, sun

reduced residue levels below the MRLs

Pesticides in lakes and rivers

data cochabamba and chuquisaca 2009

- All water samples (n=27) had detectable pesticide residues Atrazin, Heptachloro, Aldrin, Chlorpyrifos, Dieldrin, Endrin
- 82% exceeded MCL levels (maximum contaminant level), in some cases severely

OPEN ACCESS

Original research

Organophosphate and carbamate insecticide exposure is related to lung function change among smallholder farmers: a prospective study

Martin Rune Hassan Hansen [1,2] Erik Jørs,[3,4] Annelli Sandbæk [5,6] Daniel Sekabojja [7] John C Ssempebwa [8] Ruth Mubeezi [8] Philipp Staudacher [9,10] Samuel Fuhrimann [11] Torben Sigsgaard [1] Alex Burdorf [12] Bo Martin Bibby,[13] Vivi Schlünssen [1,2]

http://dx.doi.org/10.1136/thoraxjnl-2020-214609

- A cohort of 364 smallholder farmers in Uganda (69% women), participants underwent pre-bronchodilator spirometry at baseline (September/October 2018) and at two follow-up visits (November/December 2018 and January/February 2019). Exposure to carbamate and organophosphate insecticides was assessed using haemoglobin-adjusted erythrocyte acetylcholinesterase (AChE/Hb)
- Low AChE/Hb was significantly associated with low FEV1 Z-score in both unadjusted and adjusted analyses
- Exposure to organophosphate and carbamate insecticides may lead to lung function decline.

OPEN ACCESS

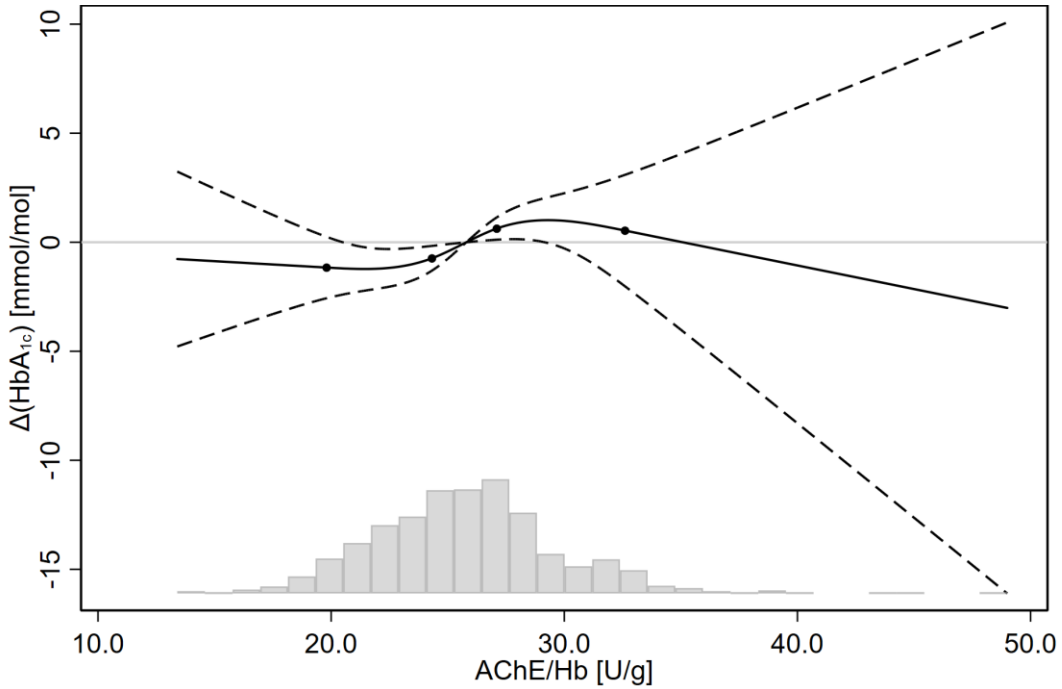
ORIGINAL RESEARCH

Exposure to cholinesterase inhibiting insecticides and blood glucose level in a population of Ugandan smallholder farmers

Martin Rune Hassan Hansen ,[1,2] Erik Jørs,[3,4] Annelli Sandbæk,[5,6] Daniel Sekabojja,[7] John C Ssempebwa,[8] Ruth Mubeezi,[8] Philipp Staudacher,[9,10] Samuel Fuhrimann ,[11] Alex Burdorf,[12] Bo Martin Bibby,[13] Vivi Schlünssen[1,2]

http://dx.doi.org/10.1136/oemed-2020-106439

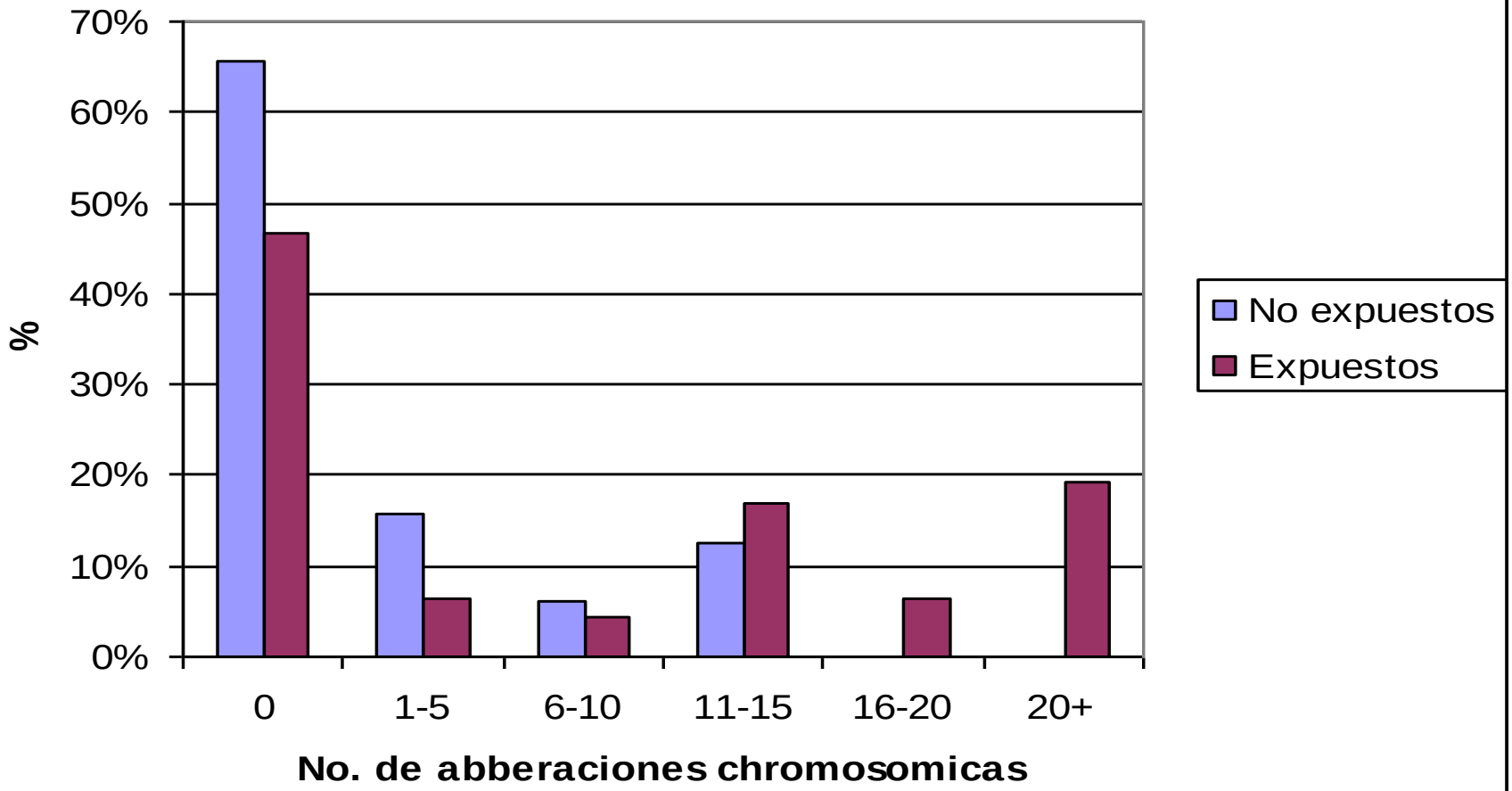
HbA_{1c}



Adjusted for age, sex, alcohol consumption in last week, tobacco consumption in the last week, MET-minutes of physical activity in the last week, servings of fruits and vegetables consumed per day in the last week

Genetic Alterations in Pesticide Exposed Bolivian Farmers: An evaluation by analysis of chromosomal aberrations and the comet assay

Jørs E et al Biomarker Insights. 2, s. 439-445



Exposure to Sub-Lethal Doses of Permethrin Is Associated with Neurotoxicity: Changes in Bioenergetics, Redox Markers, Neuroinflammation and Morphology

Toxics

2021 Dec 6;9(12):337. doi: 10.3390/toxics9120337.

Teresita Guadalupe López-Aceves et al

Exposure to Sub-Lethal Doses of Permethrin Is Associated with Neurotoxicity: Changes in Bioenergetics, Redox Markers, Neuroinflammation and Morphology

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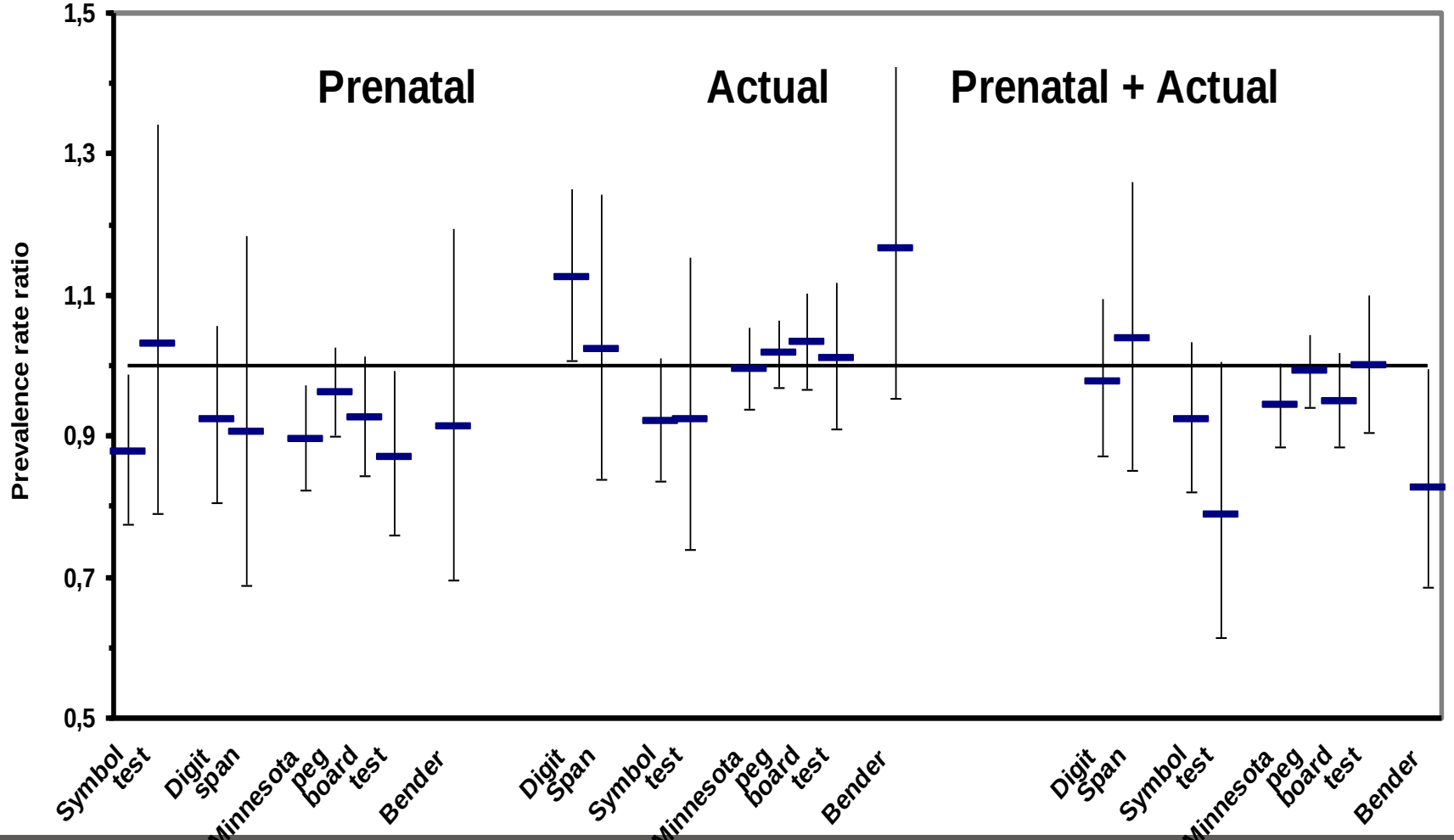
Effects on the fetus

NEGATIVE EFFECTS ON DEVELOPM. IN CHILDREN, No 292 (age 7-9 years)



Neurobehavioral deficits and increased blood pressure in school-age children prenatally exposed to pesticides

Environ Health Perspect

2010 Jun;118(6):890-6. doi: 10.1289/ehp.0901582. Epub 2010 Feb 25.

Philippe Grandjean et al.

Environmental and occupational pesticide exposure and human sperm parameters: A Navigation Guide review

Consistent finding of significant negative associations between pesticide exposure and sperm quality in 13 of 20 (65 %) studies published between 1991 and 2008, and in 14 of 17 (82 %) studies published between 2008 and 2012.

After thirty years of mounting evidence, actions are needed to reduce pesticide risks to testicular function and male fertility.

Toxicology 2022 Jan 15;465:153017. doi: 10.1016/j.tox.2021.153017. Epub 2021 Oct 29.

Eric T Knapke et al

Fruits and Vegetables and Pregnancy Outcomes Among Women Undergoing Infertility Treatment With Assisted Reproductive Technology

In a cohort of 325 women undergoing infertility treatment with assisted reproductive technology, intake of high–pesticide residue fruits and vegetables was associated with a lower probability of live birth, while low–pesticide residue fruit and vegetable intake was not associated with this outcome.

JAMA Intern Med. 2018;178(1):17-26. doi:10.1001/jamainternmed.2017.5038 Published online October 30, 2017.

Yu-Han Chiu et Al

Interventions to Reduce Pesticide Exposure from the Agricultural Sector in Africa: A Workshop Report

Int. J. Environ.
Res. Public Health 2022, 19, 8973.
https://doi.org/10.3390/ijerph1915897

A broad range of **topics** relevant to occupational and environmental health risks were discussed such as acute poisoning, street pesticides, switching to alternatives, or disposal of empty pesticide containers.

Key areas of improvement identified were training on pesticide usage techniques, research on the effectiveness of interventions targeted at exposure reduction and/or behavioral changes, awareness raising, implementation of adequate policies, and enforcement of regulations and processes.

PREVENTIVE MEASURES TO REDUCE ACCESSIBILITY

- Legislation
- Restrict sale to special shops and farmers with license to spray
- Ban class I and II pesticides
- Train farmers and spraymen in Integrated Pest Management and ecological farming methods
- Lock up pesticides
- Control of pesticide residues in food and water

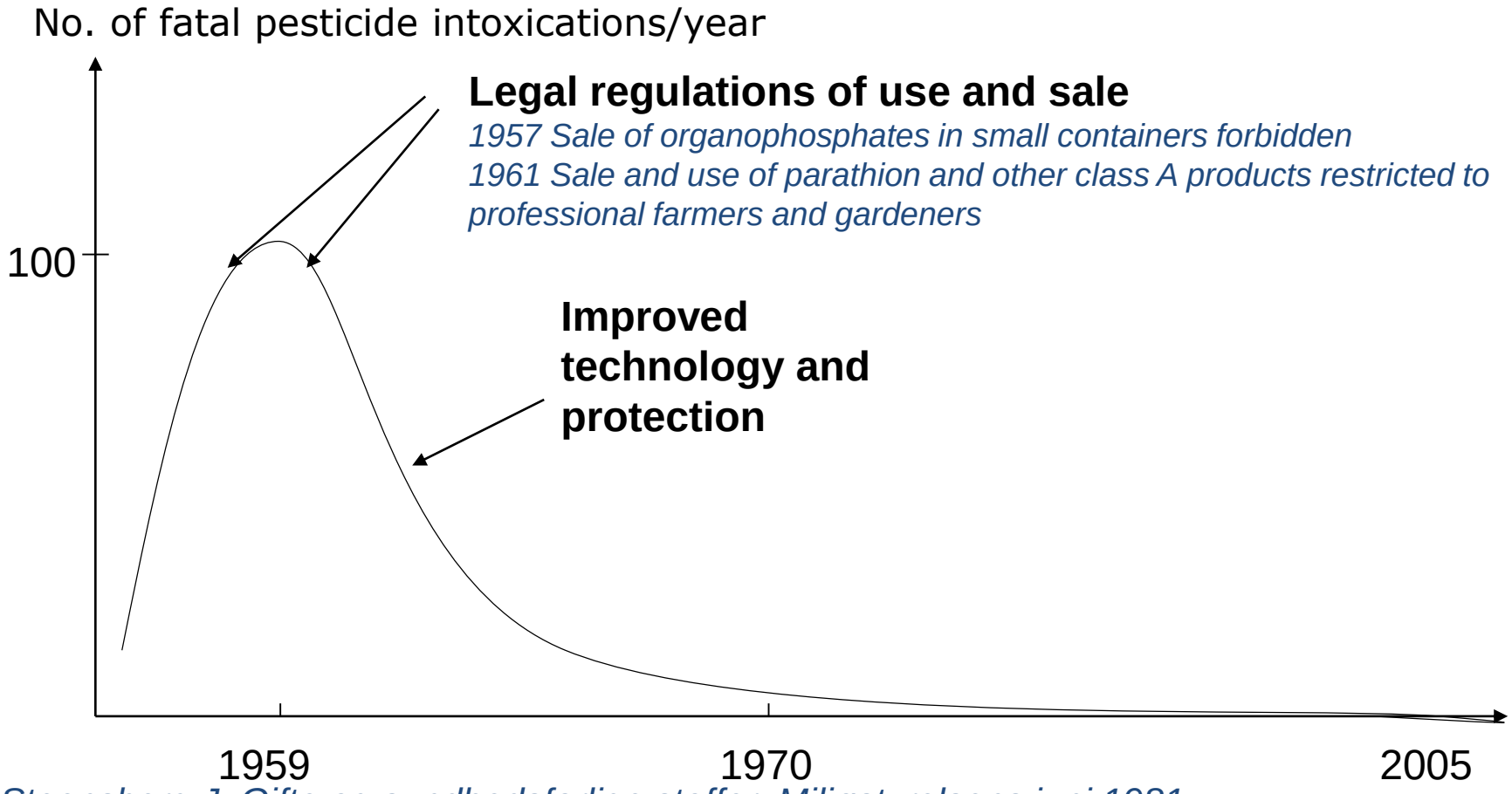
Legislation and conventions

- Basel Convention (to protect human health and the environment against the adverse effects of hazardous wastes)
- Stockholm Convention (to protect human health and the environment from persistent organic pollutants.)
- Rotterdam Convention (to promote shared responsibility and co-operative efforts among the Parties in the international trade of dangerous chemicals in order to protect human health)
- FAO Code of Conduct
- FAO/ILO/WHO guidelines for personal protection
- National legislations

But although signed often not implemented!

Positive example - Legislation – *Denmark*

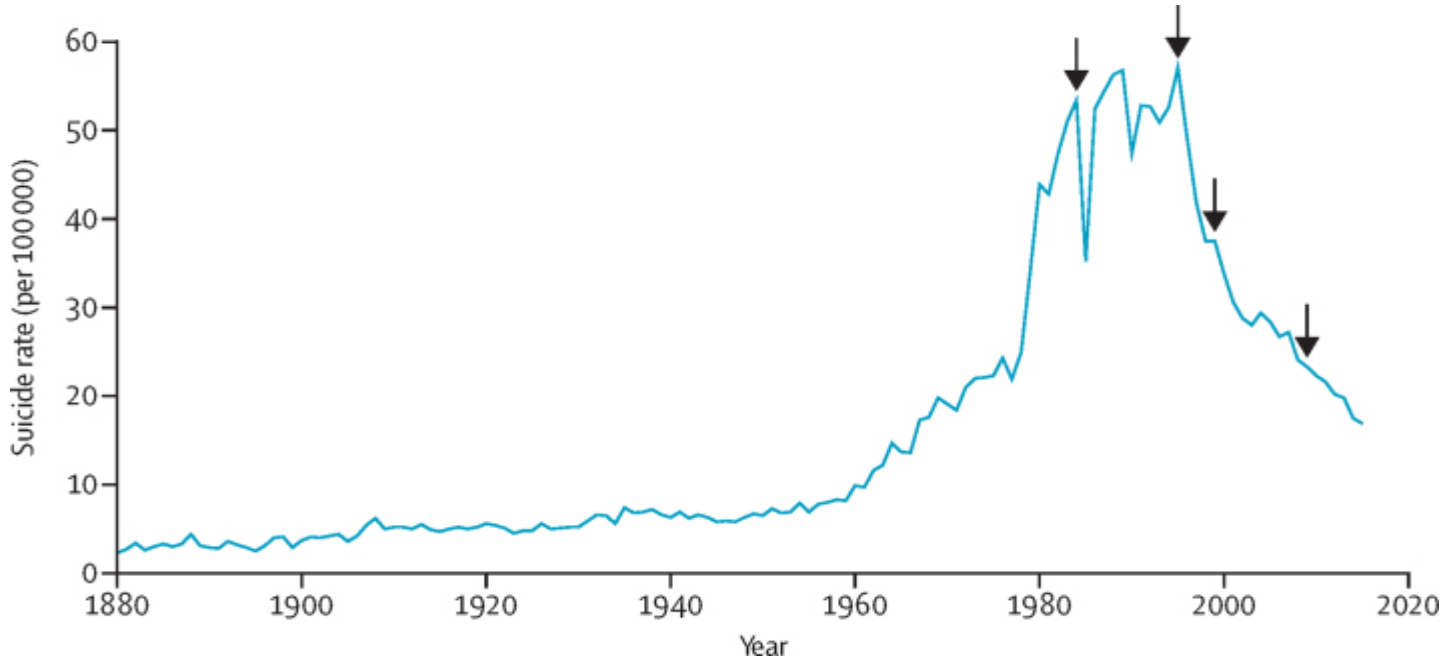
Restriction of pesticide/Bladan (methylparathion) use



Steensberg J: Gifte og sundhedsfarlige stoffer. Miljøstyrelsens juni 1981.
Figure by Lander F 2011.

Preventing deaths from pesticide self-poisoning—learning from Sri Lanka's success

DW Knipe et al Lancet Glob Health, 5 (2017), pp. e651-e652



Arrows show timing of pesticide bans in 1984 (parathion and methylparathion), 1995 (all remaining WHO class 1 toxicity pesticides, including methamidophos and monocrotophos), 1998 (endosulfan), and 2008 (dimethoate, fenthion, and paraquat). Suicide data were obtained from police records. Reproduced from Knipe et al.17

Training in IPM and FFS concepts

- Reduce pesticide use
- Personal protection
- Less toxic products
- Ecological methods

- Participatory approach
- Adult learning methods
- Bottom up approach
- Discovery based pratical learning

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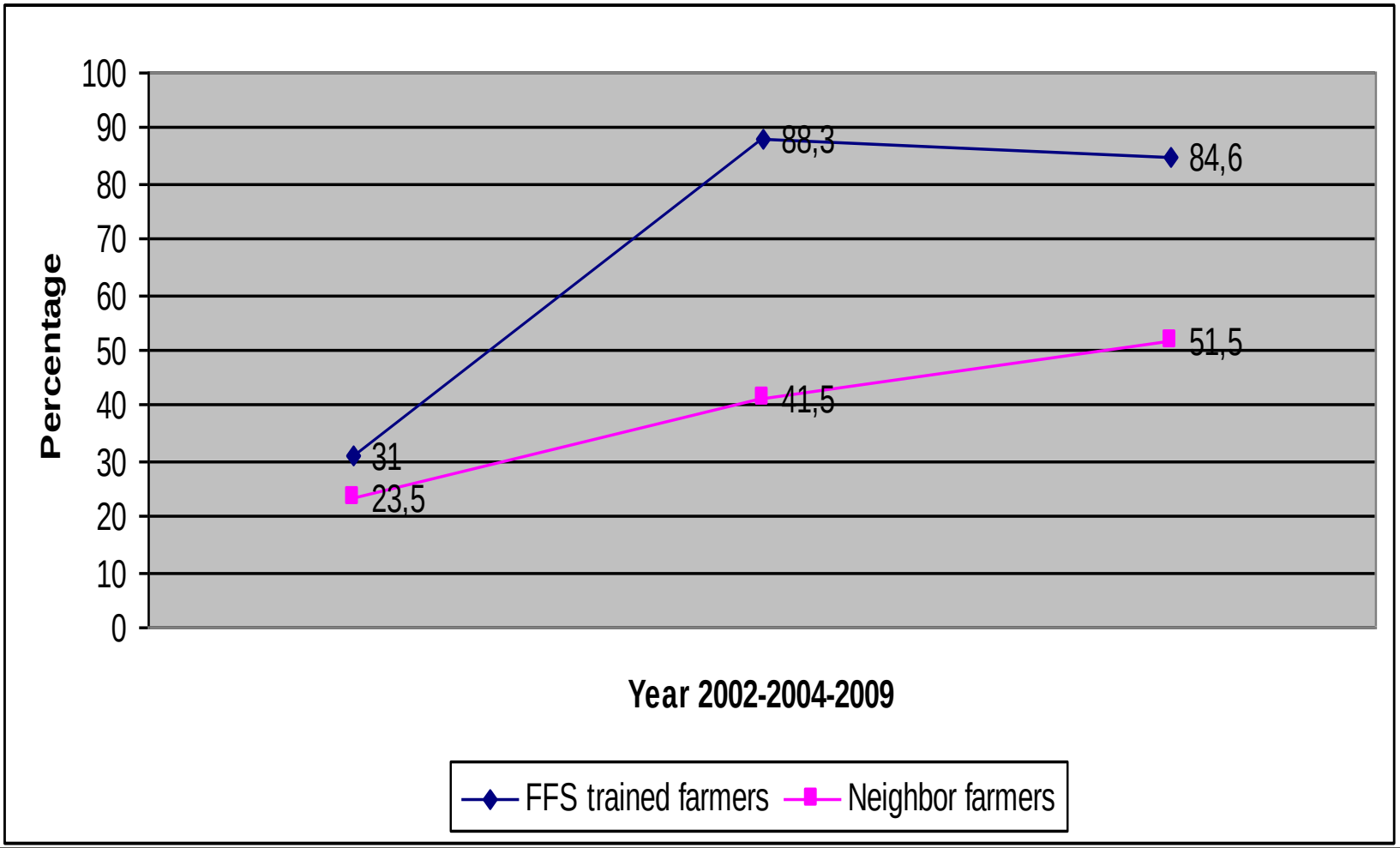
PPE use after IPM training

By: Jørs Erik[1]*, Konradsen Flemming[2], Huici Omar[3], Morant C Rafael[3], Volk Julie[4], Lander Flemming[5]. 2016



Obstacles and possibilities for diffusion of Integrated Pest Management strategies among Bolivian farmers to control negative consequences of inadequate pesticide use! Envir Health Insights 2917 Jørs E et al

Advantages

- Cultural acceptable
- Healthier products
- Less inversion
- No poisonings and pesticide related chronic diseases
- An increasing demand especially around bigger cities
- Easier to export products

Disadvantages

Too much extra work

Technically more complicated

Prices not better than conventional grown products

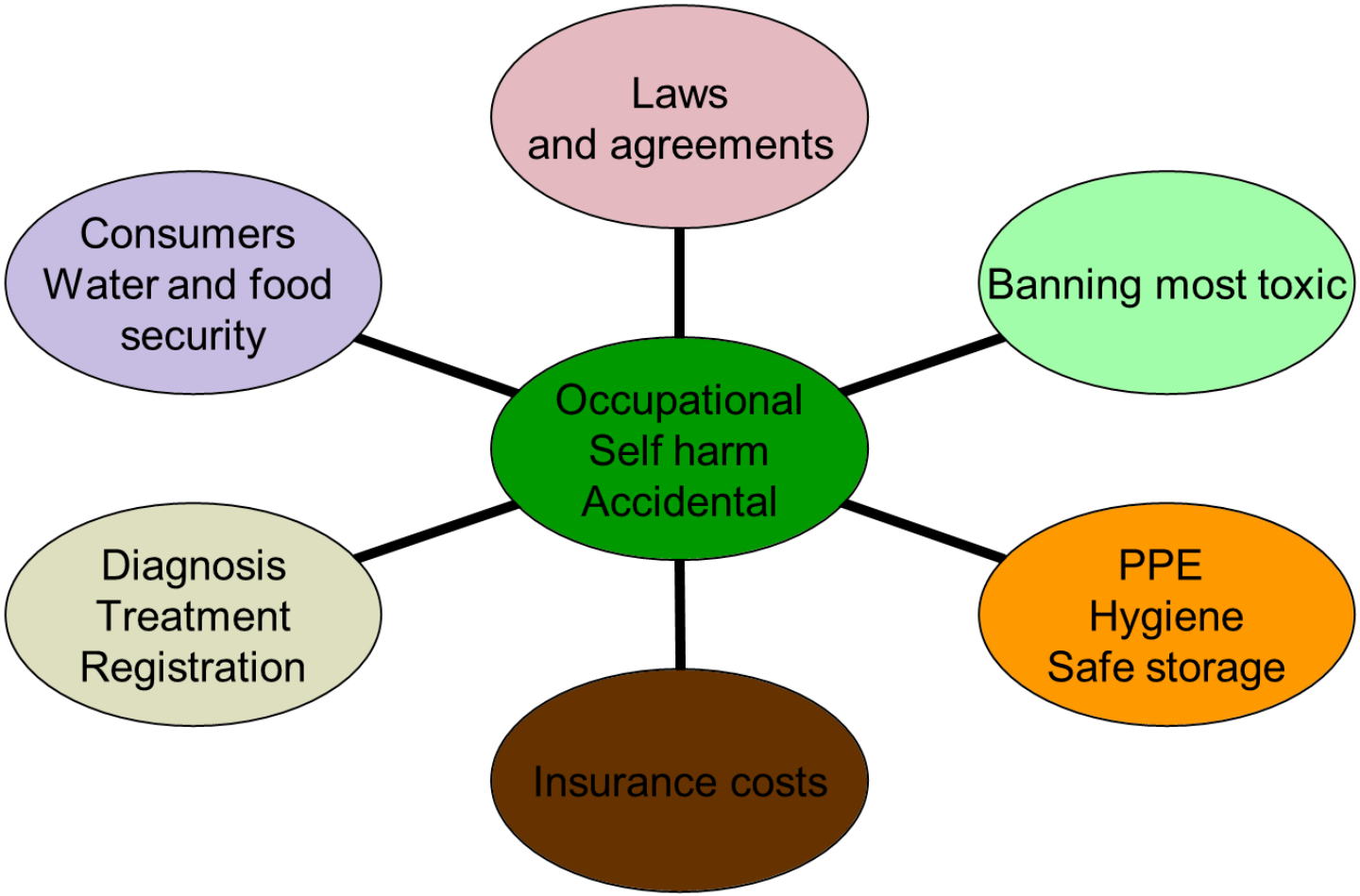
Massive pest attacks

Pressure from banks giving loans

Government policies to improve agricultural production

Management of Empty Pesticide Containers—A Study of Practices in Santa Cruz, Bolivia

Conclusion


Laws
and agreements
Consumers
Water and food
security
Banning most toxic
Occupational
Self harm
Accidental
Diagnosis
Treatment
Registration
PPE
Hygiene
Safe storage
Insurance costs

Thank you

Erik.joers@rsyd.dk