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Pesticides Use in Thailand and Developmental Effects on Children

Tippawan PRAPAMONTOL, PhD

Environment and Health Research Unit,
Research Institute for Health Sciences, Chiang Mai University, Thailand

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Outline

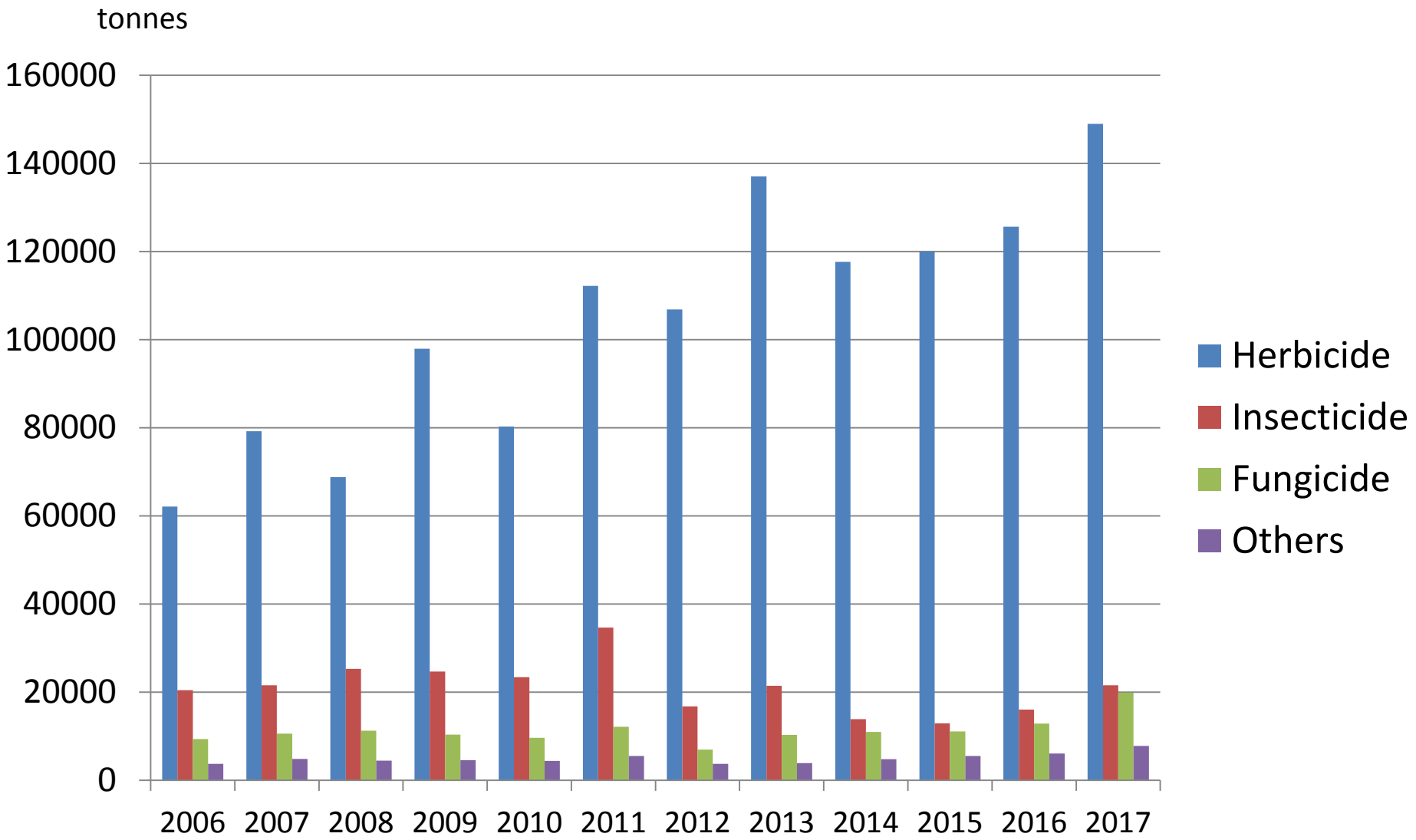
- Pesticide use in Thailand
- Pesticide residues in fruits and vegetables
- Exposure monitoring
- Field studies
    - adults
    - pregnant women and newborns
    - young children

Pesticide Use in Thailand

- Pesticides have been widely used in agriculture in Thailand
- Herbicides are dramatically increased in 12 years, average 9.4% per year
- **Herbicides**: glyphosate, paraquat and phenoxyacetic acid

  (i.e. 2, 4-Dichlorophenoxyacetic acid ; 2,4,5- Trichlorophenoxyacetic acid)
- **Insecticides**: organophosphates (OPs) and pyrethriods (PYRs) are common used.

Pesticides Imported into Thailand (2006-2017)



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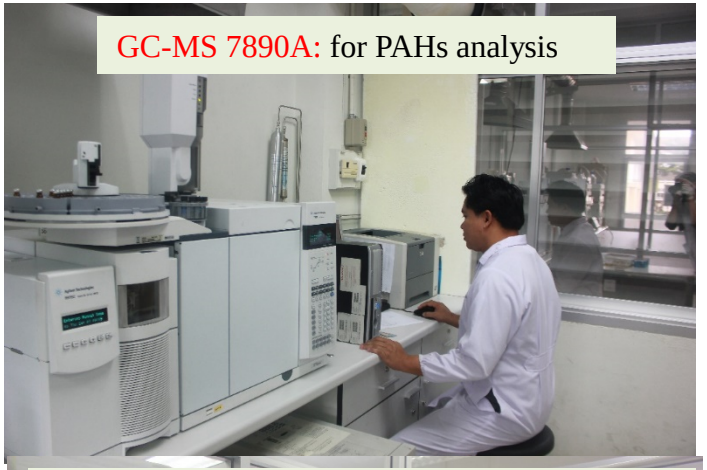
Pesticides vs Analytical Techniques

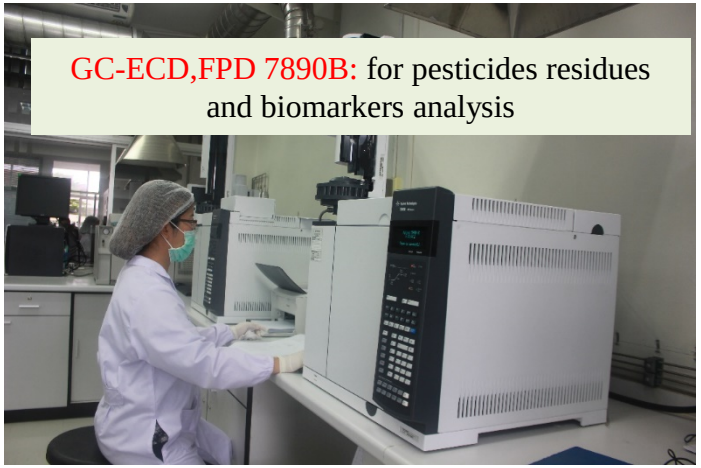
- Mostly focus on insecticides i.e. OPs, PYRs
- Herbicides: glyphosate
- Analytical instrumentations:
  - GC-FPD: OP residues
  - GC-ECD: PYR residues
  - GC-MS: Other organic pollutants
    i.e. Polycyclic Aromatic Hydrocarbons (PAHs)
  - HPLC-FLD: glyphosate

Instruments at Research Institute for Health Sciences, Chiang Mai University

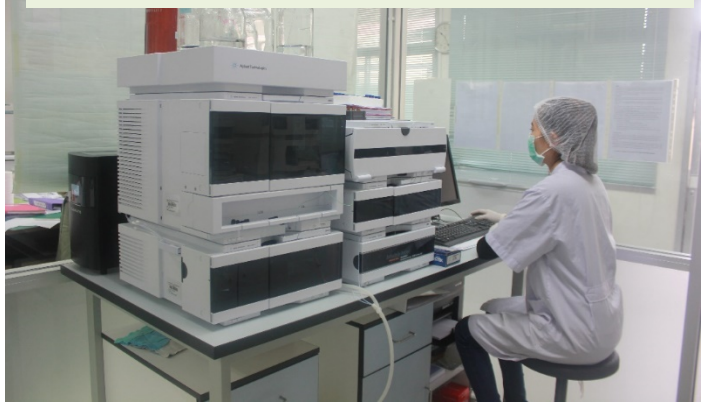
GC-MS 7890A: for PAHs analysis



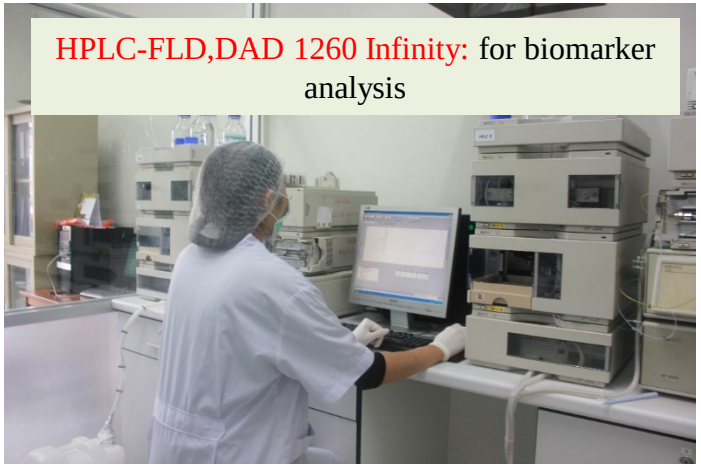
GC-ECD,FPD 7890B: for pesticides residues and biomarkers analysis



HPLC- UV,FLD HP110: for biomarkers analysis



HPLC-FLD,DAD 1260 Infinity: for biomarker analysis



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Pesticide Residues in Northern Provinces

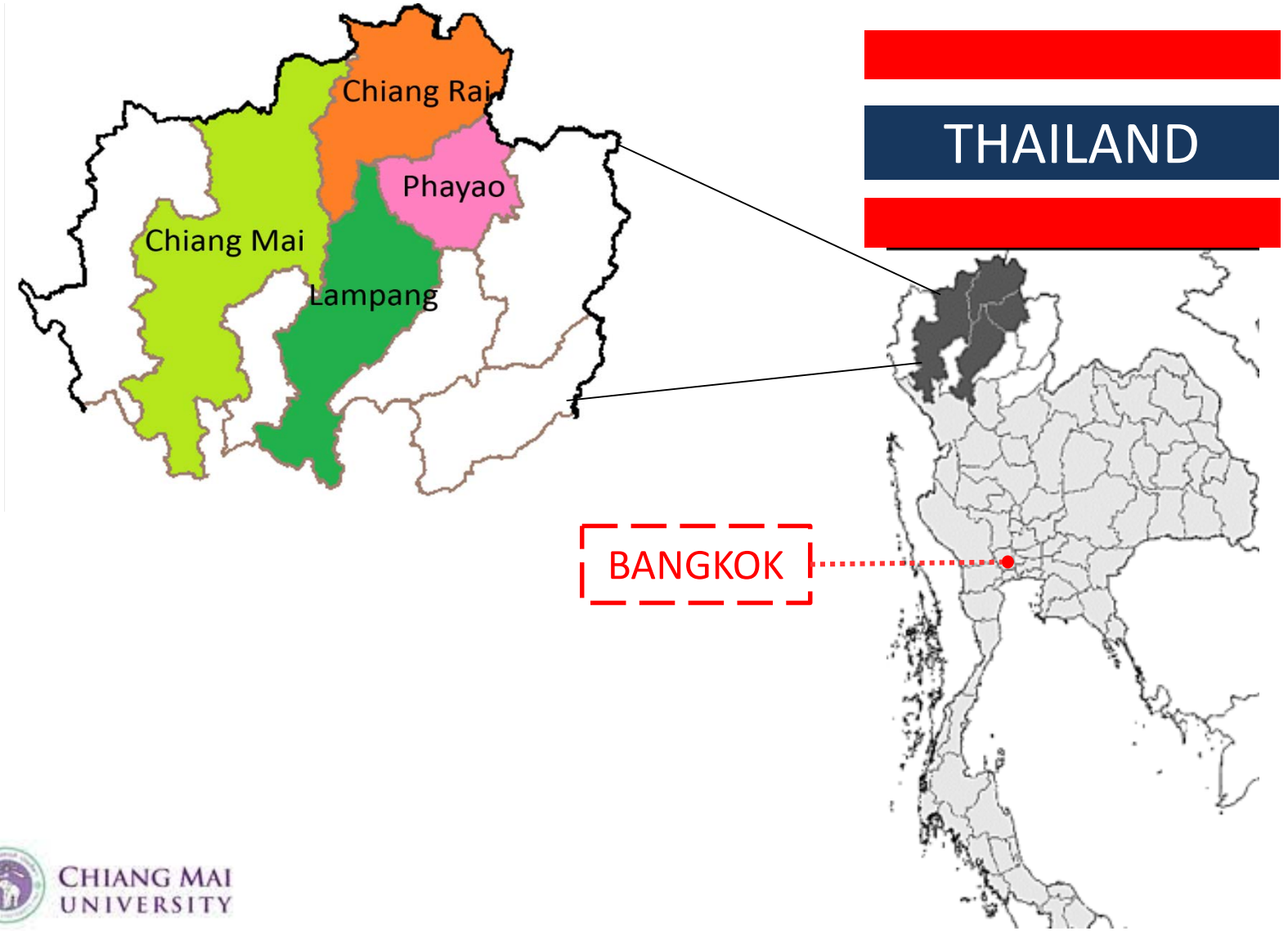
- A survey series on pesticide residues in vegetable and fruit samples sourced from markets in upper northern Thailand during 2007–2013. Few more but in ongoing.

- Sixteen different vegetables (n=412 samples)

- Eleven different fruits (n=301 samples)
- Analyses of 43 pesticides including
  - 20 organophosphates (OPs),
  - 6 synthetic pyrethroids (PYRs),
  - 12 carbamates,
  - Others: 2 abamectins, imidacloprid, dithiocarbamates, and carbendazim.

Prapamontol et al, 2019 (In press).

Pesticide Residues:
4 Provinces in Upper Northern Thailand



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What Methods We Used?

Organophosphate (OP) residues

using GC-FPD (Polyiem et al., 2018)

OPs in human plasma and milk

using GC-FPD (Naksen et al., 2016)

Synthetic pyrethroids (PYR) residues

using GC-ECD (Pakvilai et al., 2015)

PYR metabolite, 3-Phenoxybensoic acid (3-PBA)

using GC-ECD and immunoassay (with Prof. B.D. Hammock, UCD)

Pesticide Residues Found

- Total 412 vegetable samples,
  - 235 (57%) had pesticide residues and
  - 185 (45%) had pesticide residues that exceeded the maximum residue limits (MRLs).

- Total 301 fruit samples,
  - 245 (81%) had pesticide residues and
  - 165 (55%) had pesticide residues that exceeded the MRLs.

Prapamontol et al, 2019 (In press).

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Current Facility of Exposure Study at Toxicology Lab, RIHES

Human exposure monitoring

- Exposure to OPs - Six Dialkylphosphates (DAPs) including DAP, DMTP, DMDTP, DEP, DETP, and DEDTP using GC-FPD (Prapamontol et al., 2014).
- For QA/QC of DAPs; Participation of G-EQUAS testing
- Internal quality control

Pesticide Residues Found

- Multiple synthetic pyrethroid residues found higher levels, cypermethrin was the most frequently detected.

- Among the OP pesticides, chlorpyrifos was the most frequently detected pesticide.

Prapamontol et al, 2019 (In press)

Comparison with other report

Median daily intake (DI) of pesticides estimated from urinary metabolite concentrations measured for eight countries (μg/day).

DI (μg/day)	Chlorpyrifos	Parathion	Diazinon	Cypermethrin	Total[a]
USA	4.2	5.7	1.0	5.4	16.3
Greece	18.3	5.7	1.0	6.4	31.4
China	10.2	17.8	0.7	5.0	33.7
India	12.9	16.7	0.7	8.1	38.4
Saudi Arabia	4.5	6.1	3.7	6.7	21.0
Japan	3.0	7.5	2.0	3.0	15.5
Korea	9.9	10.0	3.1	7.7	30.6
Vietnam	27.9	9.3	0.7	21.8	59.7
All[b]	9.6	9.6	1.0	6.0	26.3

[a] Total refers to sum DIs of chlorpyrifos, parathion, diazinon and cypermethrin.

[b] All refers to DIs of pesticides estimated from urinary metabolite concentrations for the entire dataset from the eight countries.

Urinary concentrations and profiles of organophosphate and pyrethroid pesticide metabolites and phenoxy acid herbicides in populations in eight countries (Li and Kannan, 2018)

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Pesticide Exposure Among Reproductive-Age Farmers
Under the Collaboration with NIES, JAPAN

- **A Pilot Survey,** evaluated the exposure levels of OPs and neonicotinoids
- 50 couples of farmers in intensive agriculture areas of Chiang Mai; Fang (FA) and Chom Thong (CT) in February 2018
- Urinary DAPs were analyzed in spot urine samples.
- Personal data was collected by face-to-face questionnaire

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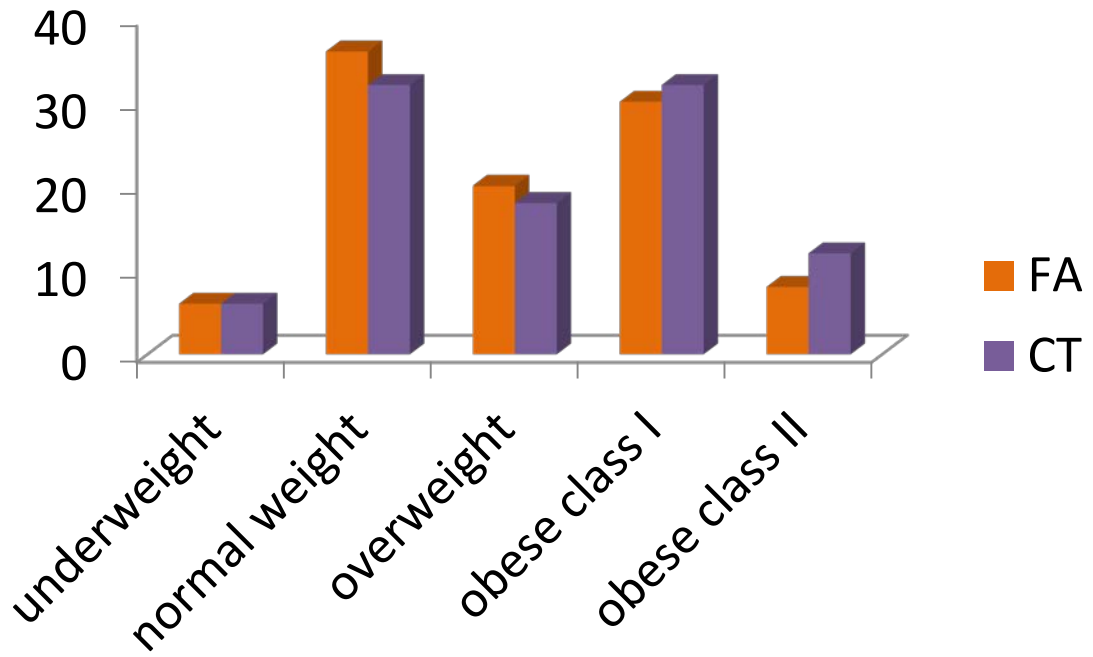
Suwannarin N, Prapamontol T, Nakayama SF, MS preparation

Personal Data of Farmers: FA and CT Sites

	FA	CT
Age	29.2	31.1
BMI	24.1	24.7



Suwannarin N, Prapamontol T, Nakayama SF, MS preparation

Farm-Working History

FANG (FA)

CHIANGMAI PROVINCE

CHIANG MAI CITY

CHOM THONG (CT)

Year as a farmer

12.3 year

Hour in field work

8.4 hour per day

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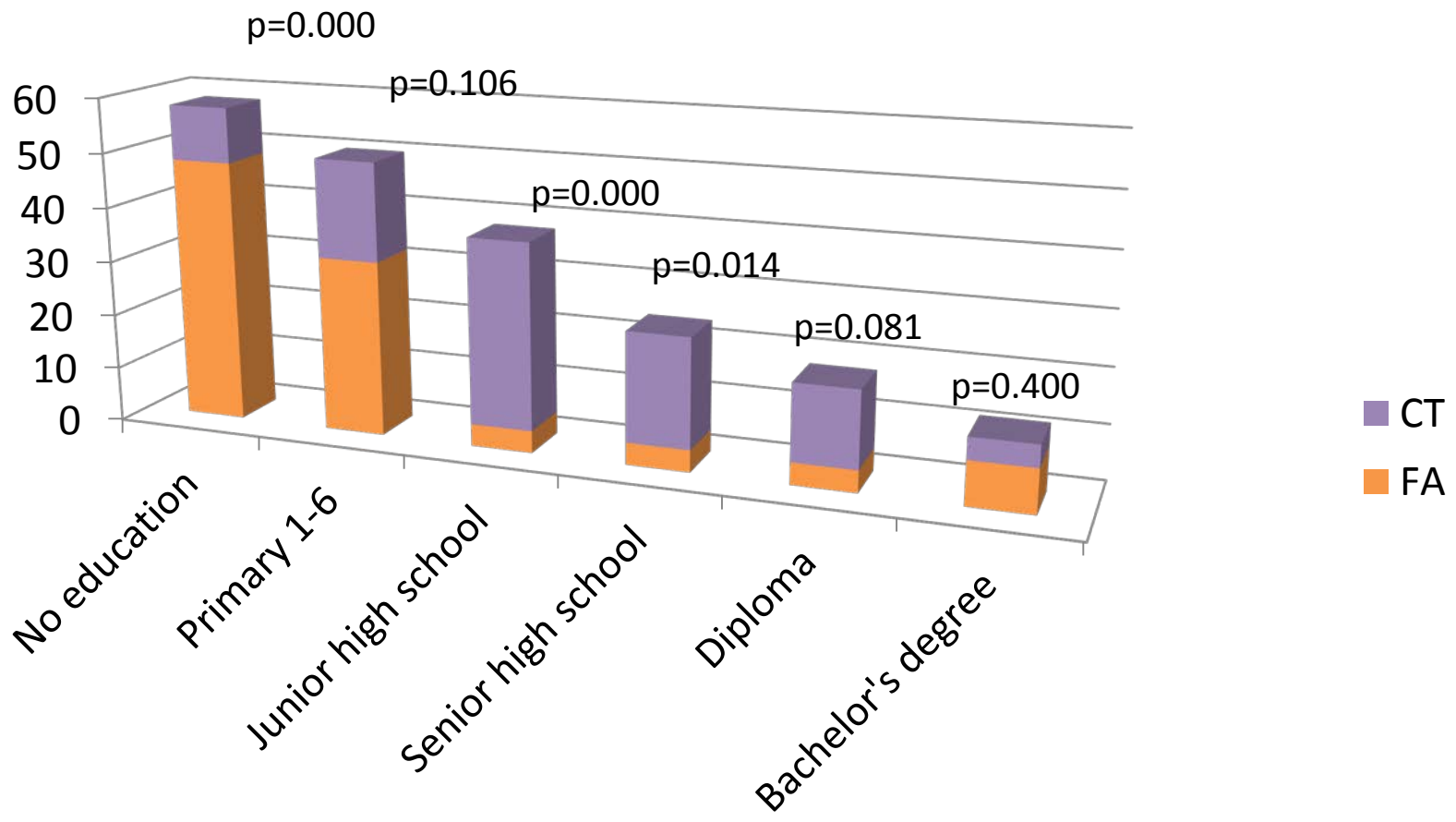
Education of Farmers: FA and CT Sites



Suwannarin N, Prapamontol T, Nakayama SF, MS preparation

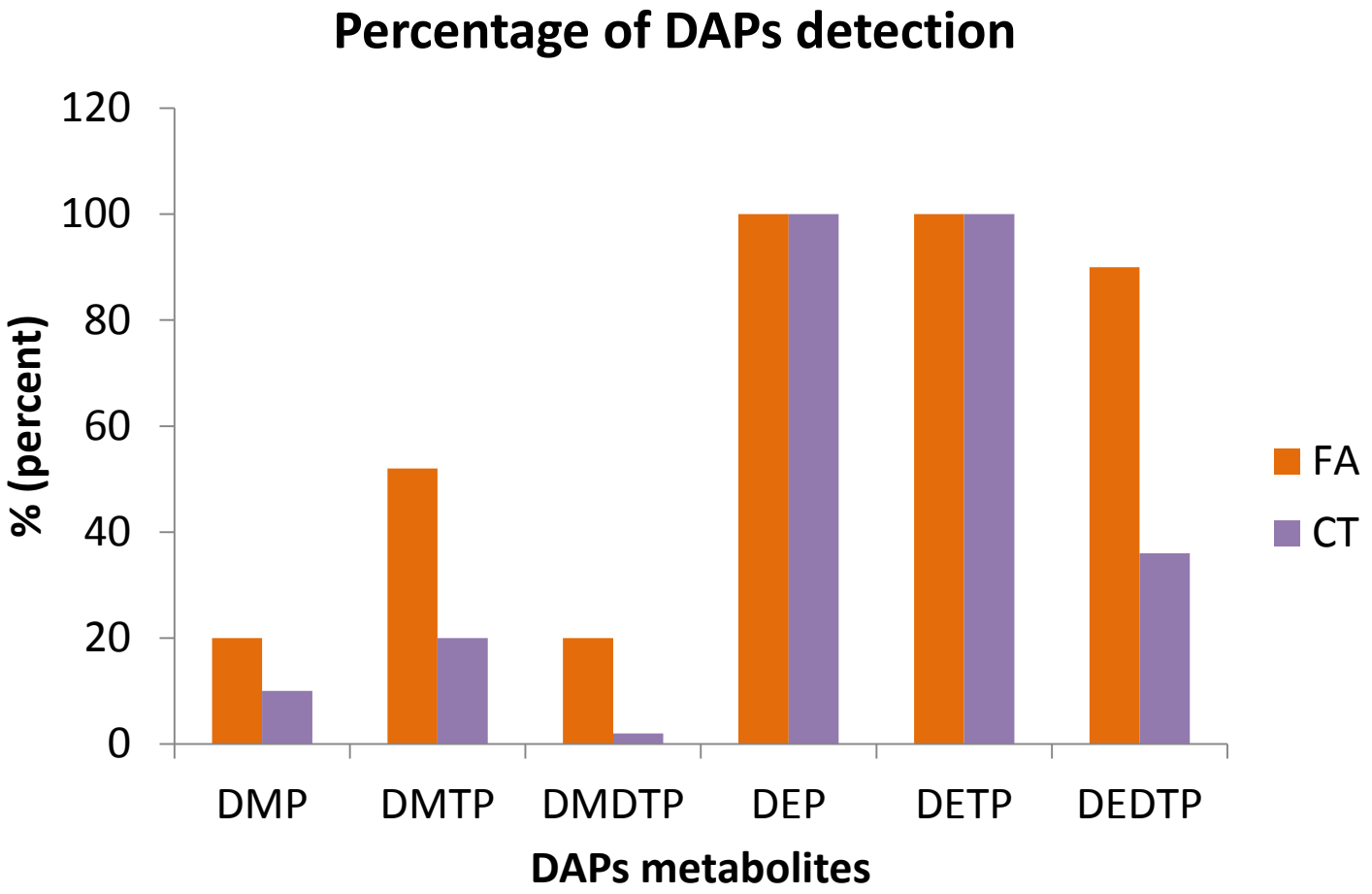
Personal Protection in Working of FA and CT Farmers

Personal protective equipment (PPE)

	n (%)			
	FA	CT	p-value	Total
wore masks	31(62)	45(90)	0.001	76(76)
wore hat or scarf as head protection	27(54)	26(52)	0.841	53(53)
Eye protection	3(6)	6(12)	0.295	9(9)
wore long-sleeved shirts/pants	40(80)	46(92)	0.084	86(86)
wore the gloves	21(42)	45(90)	0.000	66(66)
wore the boots	37(74)	46(92)	0.000	83(83)

Suwannarin N, Prapamontol T, Nakayama SF, MS preparation

Organophosphate Exposure: Six Urinary Dialkylphosphate (DAP) Metabolites



Suwannarin N, Prapamontol T, Nakayama SF, MS preparation

The Pilot Birth Cohort Study in Chiang Mai, 2011-2012

Evaluated prenatal organophosphate (OP) exposure.

Total of 52 pregnant farmworkers in Fang district, Chiang Mai province.

Investigated the changes in maternal acetylcholinesterase (AChE) and paraoxonase 1 (PON1) activities, urinary diakylphosphates (DAPs) over antenatal visits until delivery.

REF: Associations of maternal organophosphate pesticide exposure And PON1 activity with birth outcomes in SAWASDEE birth cohort, Thailand (Naksen et al., 2015).

The pilot SAWASDEE birth cohort study (continued)

- Among the individuals with low maternal PON1 activity (n=23), newborn head circumference was negatively correlated with log10 maternal ∑DEAP and ∑DAP at enrollment (gestational age=12±3 weeks; β=-1.0 cm, p=0.03 and β=-1.8 cm, p<0.01, respectively) and at 32 weeks pregnancy (β=-1.1cm, p=0.04 and β=-2.6 cm, p=0.01, respectively).

- The newborn birthweight was also negatively associated with log10 maternal ∑DEAP and ∑DAP at enrollment (β=-219.7 g, p=0.05 and β=-371.3g, p=0.02, respectively).

- This phenomenon was not observed those with high maternal PON1 activity.

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REF: Associations of maternal organophosphate pesticide exposure And PON1 activity with birth outcomes in SAWASDEE birth cohort, Thailand (Naksen et al., 2015).

SAWASDEE birth cohort study:
A cohort development in Chiang Mai, Thailand

Tippawan Prapamontol*,[1], Panrapee Suttiwan[2], Ampica Mangklabruks[3], Parinya Panuwet[4], Warangkana Naksen[1,5], Surat Hongsibsong[1], Tanyaporn Kerdnoi[1], Namtip Srirak[1], P Barry Ryan[4], Nancy Fiedler[6], Dana B. Barr[4]

[1]Research Institute for Health Sciences, Chiang Mai University, Chiang Mai,Thailand; [2]Faculty of Psychology, Chulalongkorn University, Bangkok, Thailand; [3]Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand; [4]School of Public Health, Emory University, Atlanta, GA, USA; [5]Faculty of Public Health, Chiang Mai University, Chiang Mai, Thailand; [6]School of Public Health, Rutgers University, Piscataway, NJ, USA

SAWASDEE is the Study of Asian Women and their OffSpring' s Development and Environmental Exposures
2016-2021

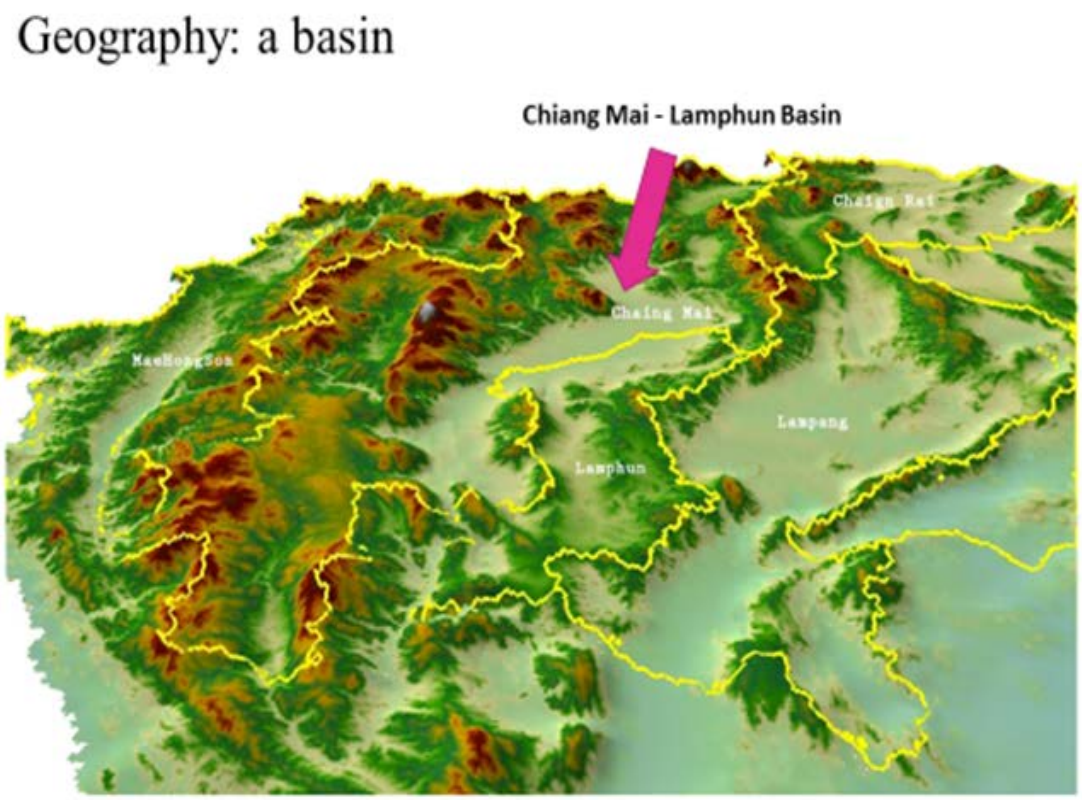
Ongoing study, 80% enrollment,
Target: 300 pregnant mothers

A Study of Exposure to POLLUTANTS Among Young Children at a Commercial Roses' Growing Village, Chiang Mai Province

- We reported the follow-up study at a commercial rose growing village, Buak Toey (BT), 25 km northwest of Chiang Mai City.
- Twenty five children aged 3-5 years old had followed up for collecting urine samples from 2 periods, dry season (March to April 2018) and wet season (July-August 2018)
- Individual urine samples were analysed for six dialkylphosphates (DAPs) as well as polycyclic aromatic hydrocarbons (1-Hydroxypyrene, 1-OHP) and malondialdehyde (MDA); biomarker of oxidative stress.
- Health questionnaire was collected from parent or guardian.

Buak Toey (BT) Roses' Growing Village

Chiang Mai Province in the Basin
“Trapping Pollution!”



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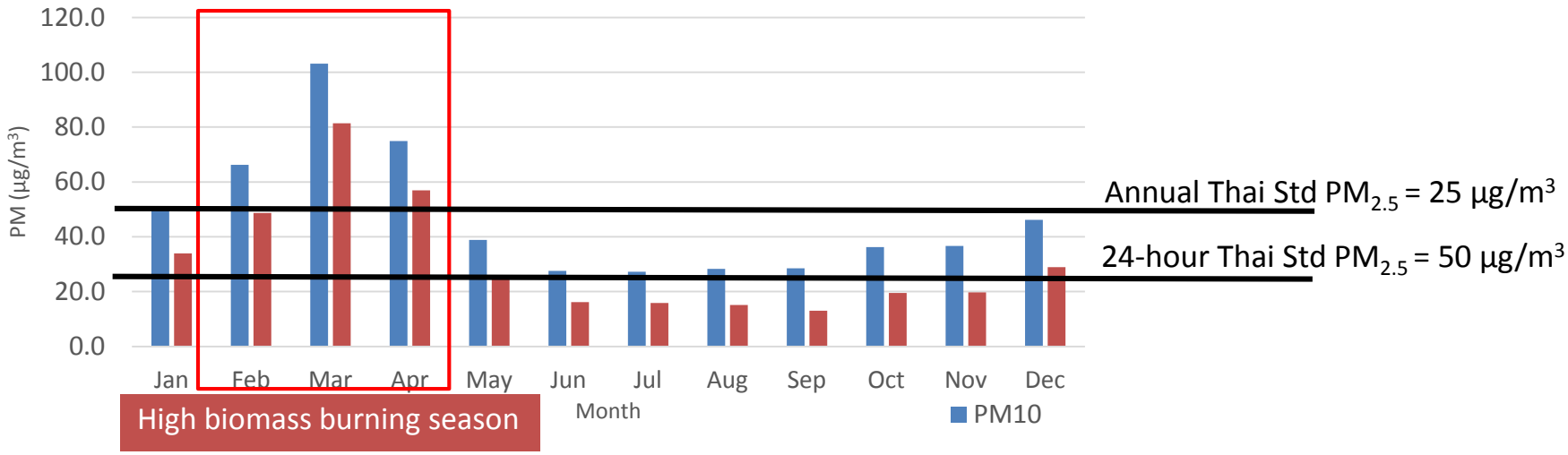
Biomass Burning in Upper Northern, Thailand "Current Environmental Health Issue"

Research Institute for Health Sciences (RIHES), Chiang Mai University (CMU)

Monthly Average of PM_{10} & $PM_{2.5}$ Concentrations in Chiang Mai: 2013-2017



Thailand Standard for PM (µg/m³)			WHO	
	PM_{10}	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
annual	120	25	20	10
24-hour	50	50	50	25

(source: Pollution control department, Thailand)

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Results of Exposure to Pollutants Among Young Children

- We found very high level of exposure to organophosphate insecticides in DRY season compared with WET season, p=0.014.

- Levels of urinary 1-OHP and MDA were not different implying no-season related exposure.

Sharing Lab Results to Parents

Summary

Pesticides (insecticides) use and their residues on vegetables and fruits indicate and need increased intervention towards safe foods.

Pesticide exposure results by urinary metabolites show high levels among young couple farmers, pregnant mothers and their newborns, and very young children in farming community.

Analytical laboratory needs to be upgraded to catch up new pollutants in the environment

We Thank..

- **Funding and Collaborating Agencies**: Chiang Mai University, National Research Council of Thailand (NRCT), USNIH, NIES Japan.
- **Participants: farmers, children**
- **Research team and graduate students**

- **Thank you ALL**

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