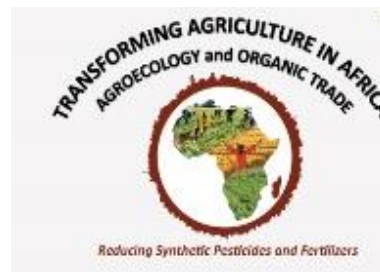




Consumer Safety: Reducing Dietary Exposure to Dithiocarbamates in Tomatoes

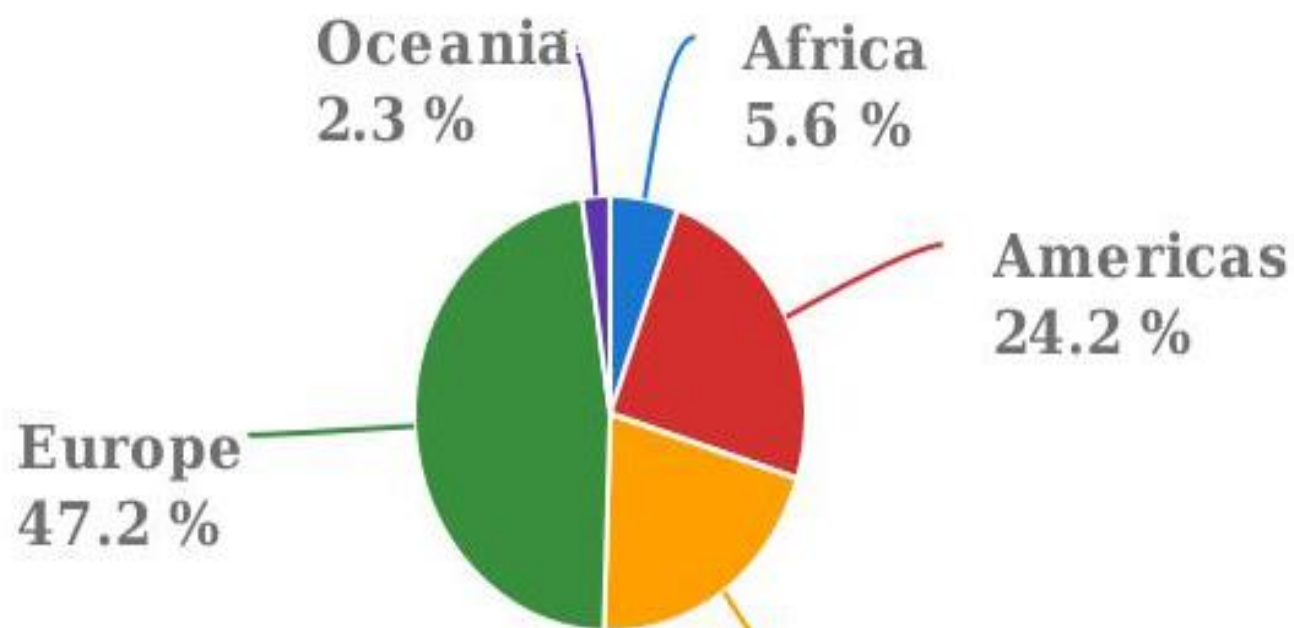
Presented by Aggrey Atuhaire



Background

Pesticides (total), Import Value by continent

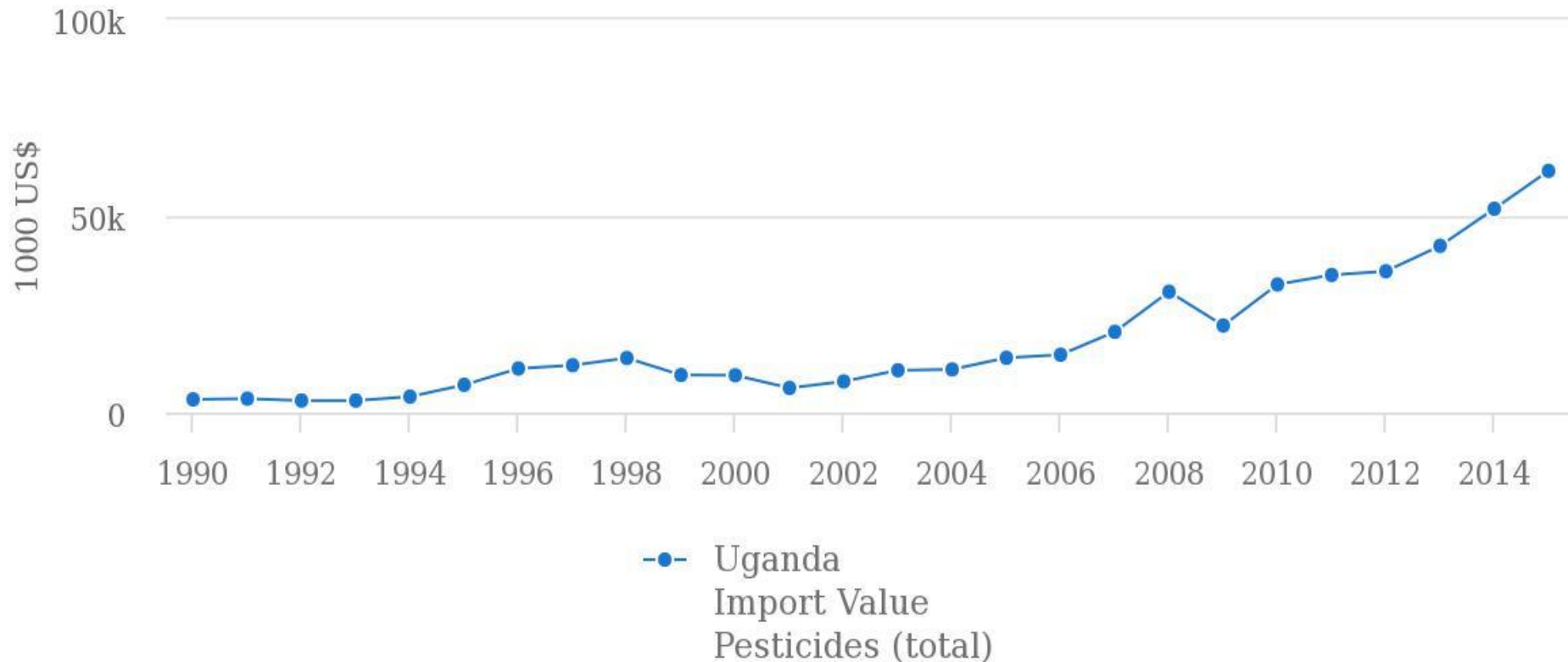
Average 1990 - 2015



Source: FAOSTAT (Apr 13, 2018)

Uganda, Pesticides (total) Import Value

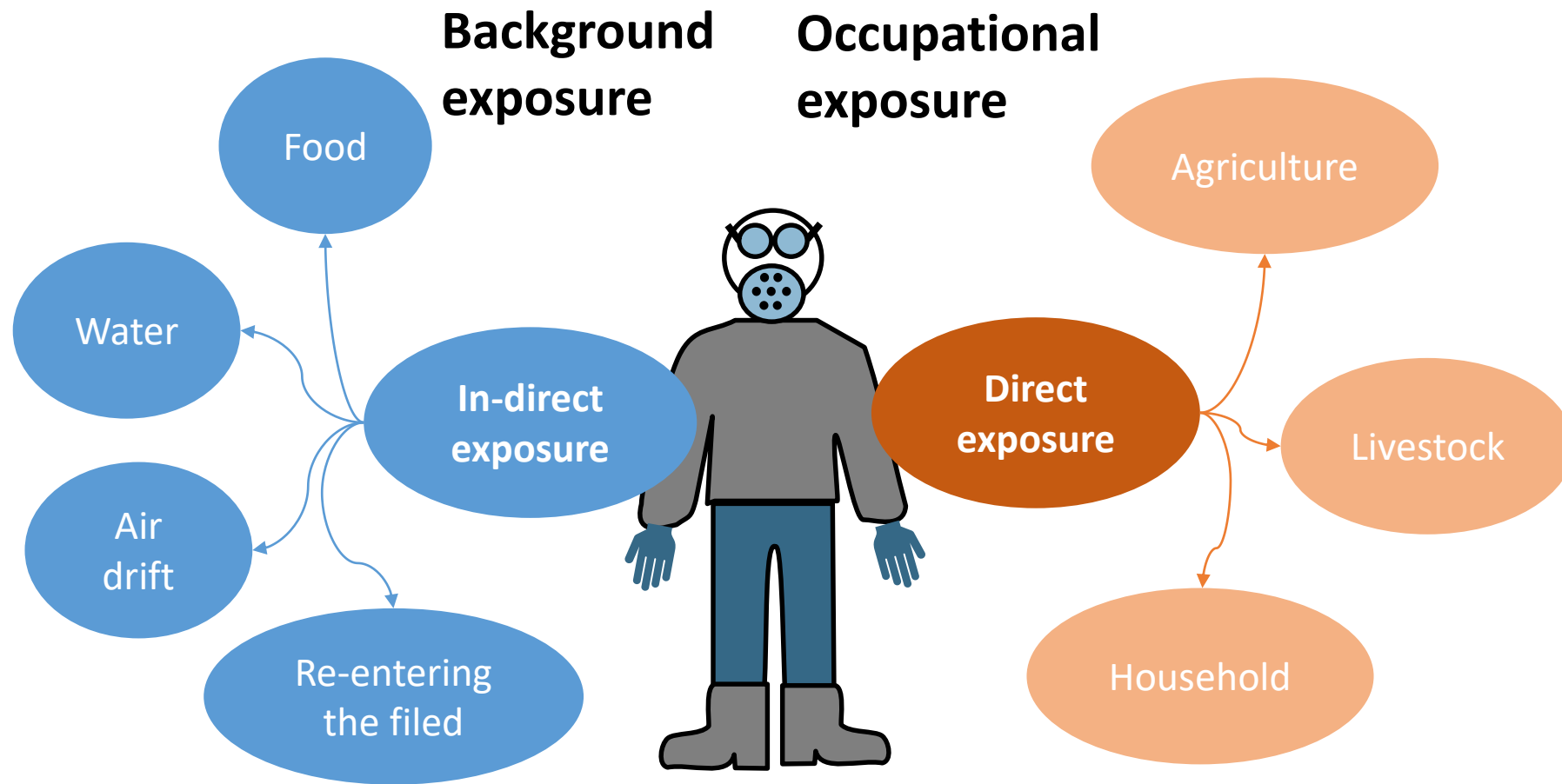
1990 - 2015



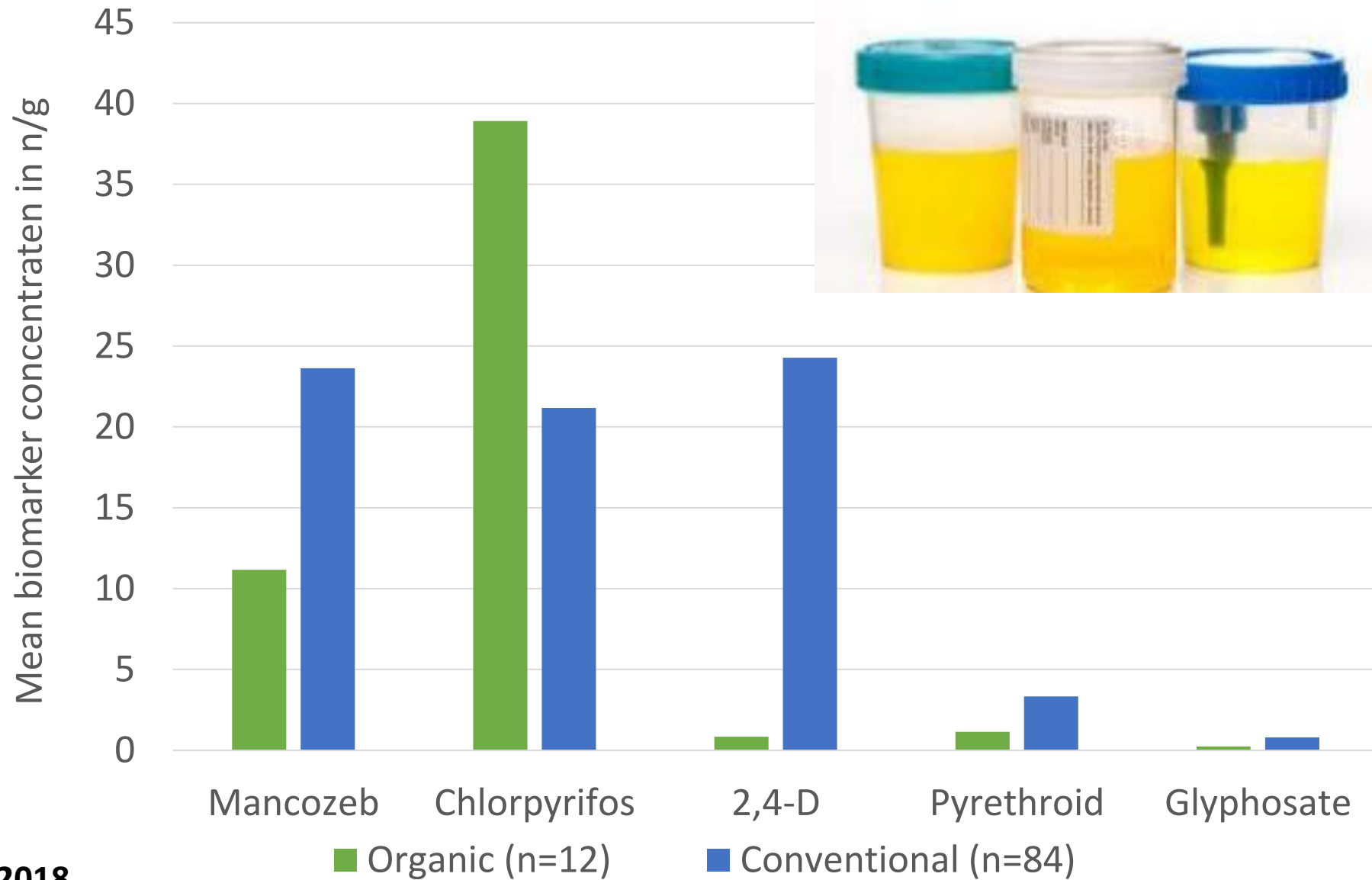
Source: FAOSTAT (Apr 13, 2018)

Pesticide importation and use in Uganda has been increasing over the years; from an estimated import value of \$3.3 million in 1990 to \$61.5 million in 2015 (FAOSTAT, 2018).....*approx. 19times fold*

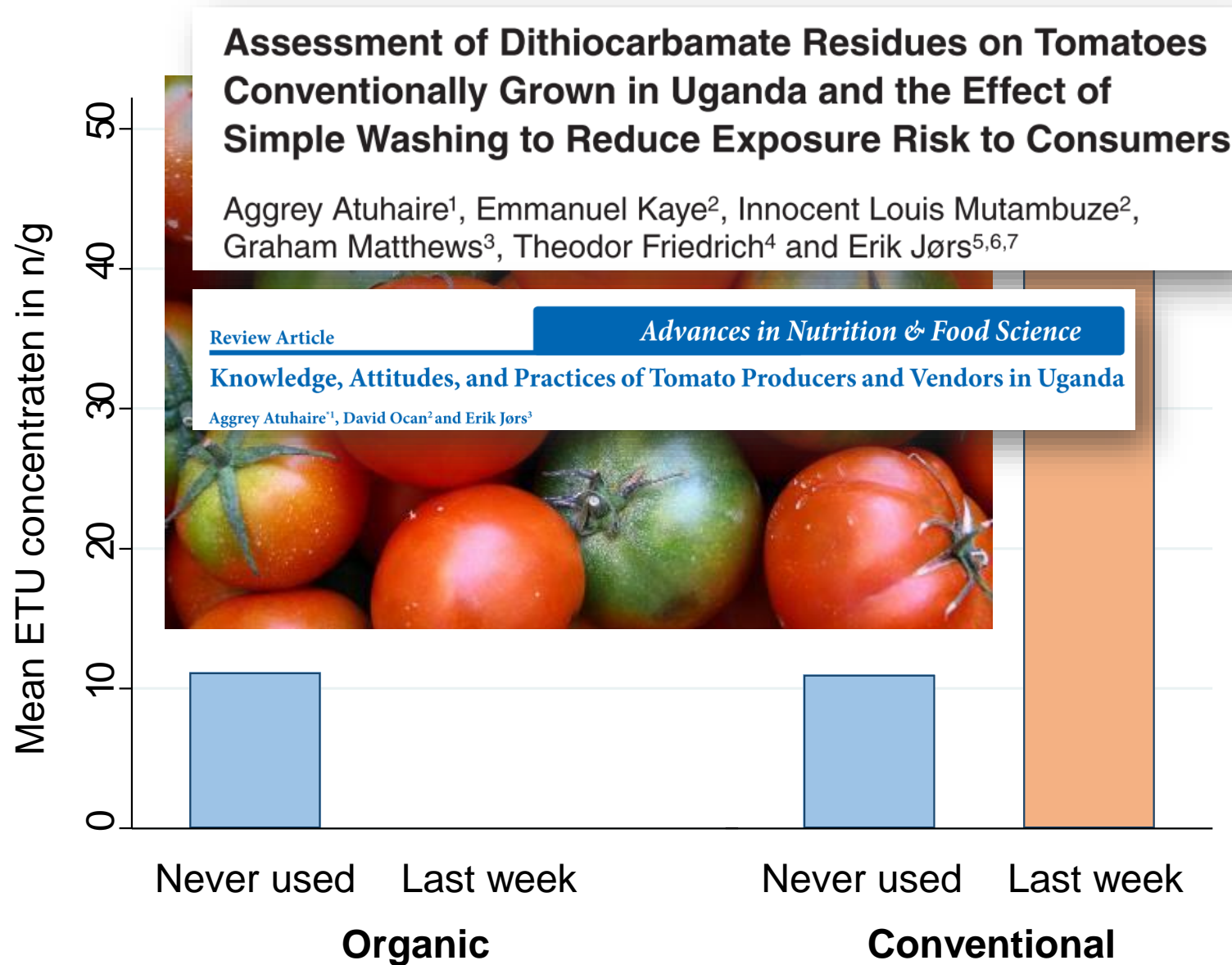
Exposure pathways



Urine biomarkers (96 samples)



Mancozeb (fungicide)
e.g. Indofil



- Although Dithiocarbamates are considered to have low acute mammalian toxicity, their association with a number of chronic effects such as endocrine disruption, alteration of immune system response, developmental defects in children, antithyroid and carcinogenic effects have been reported (EXTOXNET, 1993; Rath, 2011; Watts, 2014).

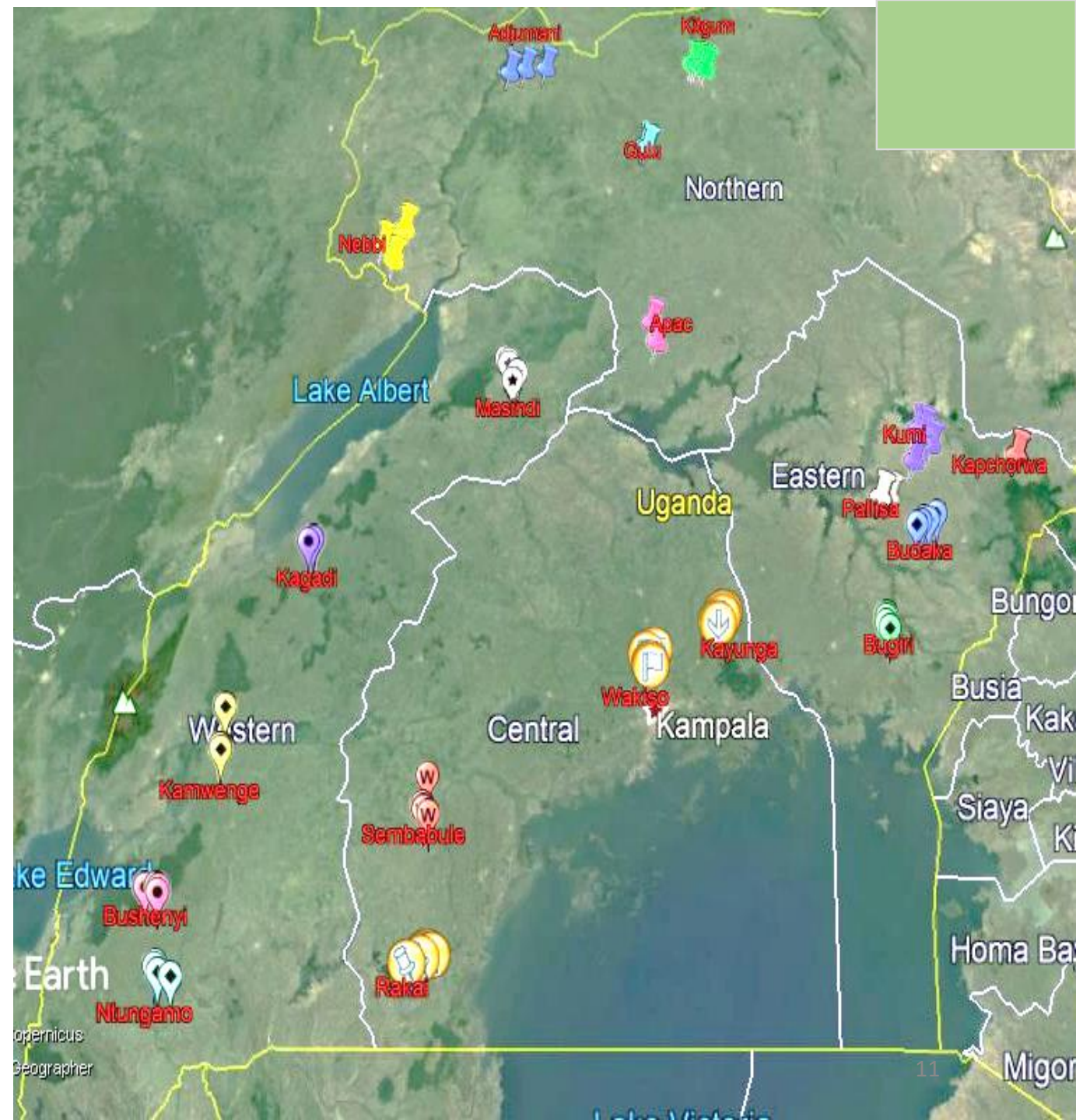
Specific Objectives

1. To ascertain tomato farmers' adherence to recommended mixing rates for Dithiocarbamate fungicides
2. To assess the level of Dithiocarbamate residues in tomatoes grown and sold in the four different regions of Uganda.
3. To determine the effect of pre-treatment conditions of cold washing, warm washing and peeling on Dithiocarbamate residue concentrations in tomatoes.

Methodology

Study area

- Uganda
- 4 regions (18 Districts) of the country
- 31 farms
- 38 market stalls
- 4 samples per source
- 276 tomato samples



		SOURCE		Total
		Market stalls	Farms	
REGION	Central	15	8	23
	Western	6	5	11
	Eastern	10	10	20
	Northern	7	8	15
Total		38	31	

Sample pre-treatments

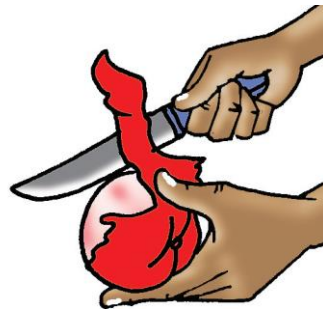
- Cold washing (room temperature)



- Warm washing (55°C)



- Peeling



- Control



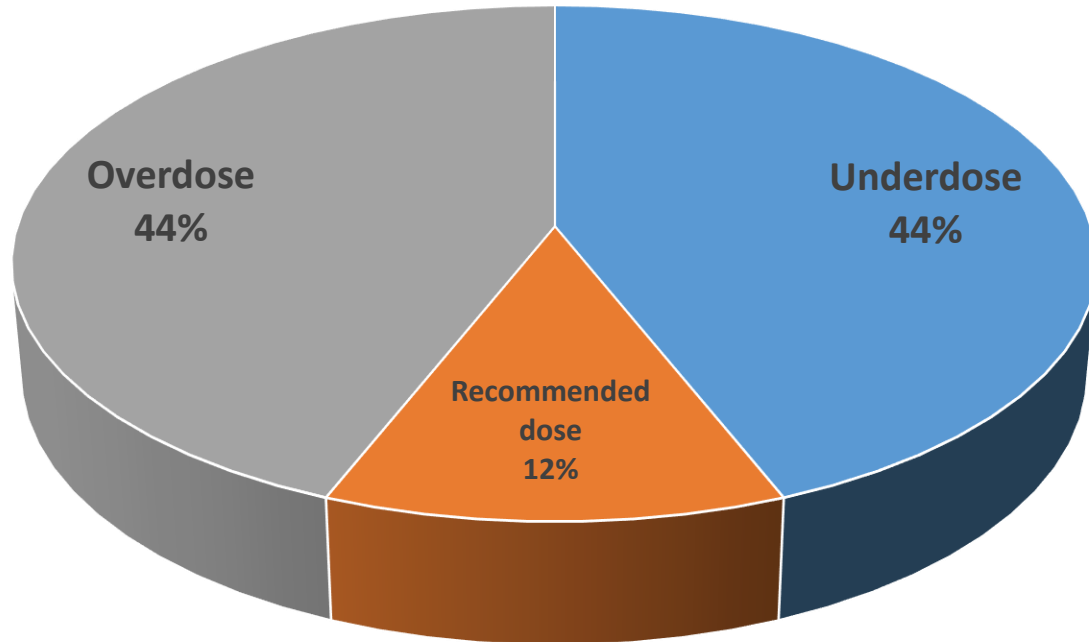
Analytical procedure

- Spectrophotometric method
- A standard analytical procedure for determination of individual Dithiocarbamates (Mancozeb, Maneb, Zineb...) using sodium molybdate (Kaur, 2011).
- On heating, Mancozeb reacts with sodium molybdate to form a blue colored complex which is then extracted into methyl isobutyl ketone (MIBK) and determined by derivative spectrophotometry.

Results

Mixing rates

Adherence of tomato farmers to recommended mixing rates for Mancozeb



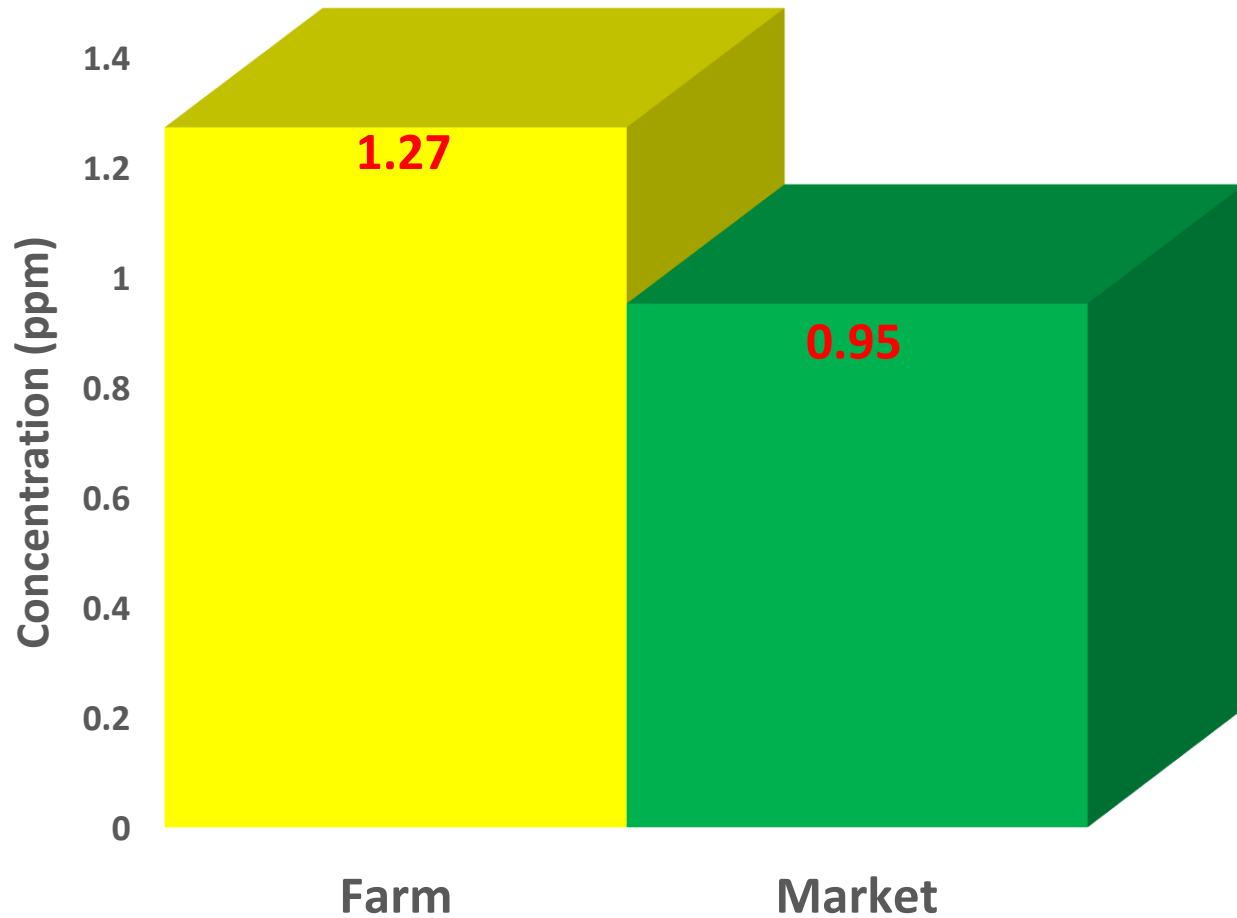
- Exceedance of the recommended **mixing rates** by 3-7 times has also been reported (Kaaya et al., 2004; Kaye et al., 2015; Atuhaire et al., 2017).
- Tomato farmers in Uganda have attributed their non-adherence to recommended mixing rates and pre-harvest intervals to among other reasons, the pursuit of extending the tomato shelf life and making tomatoes attractive to customers, as demanded by market vendors in the local markets (Atuhaire et al., 2016).
- Contrary to popular belief, in a study undertaken in Tanzania, Mtui et al., (2014) demonstrated that the use of an agroecologically friendly agronomic practice of mulching with dry grasses resulted in fruits with consistently longer shelf life for four weeks in storage compared farmer spraying regime of 14 times per crop cycle.

- Weak regulation of Uganda's pesticide industry (distributors and retailers) has resulted into a thriving trade in counterfeit pesticides, as well as unqualified pesticide sellers who offer poor/no guidance to minimally educated farmers thus contributing to the growing pesticide abuse trend in the country (Atuhaire, 2017).
- Uganda's current extension worker to farmer ratio of 1:1,800 (MAAIF, 2019) is a key factor contributing to the knowledge gap amongst farmers, hence translating into inappropriate practices such as dosage abuse as reported in this study.
- As reported in an earlier study (Atuhaire et al., 2017), mixing rates had a significant positive correlation with Mancozeb residue levels. This practice amongst the farming fraternity therefore has important implications for consumer safety

Mancozeb residue levels

Summary

Overall average concentration of Mancozeb

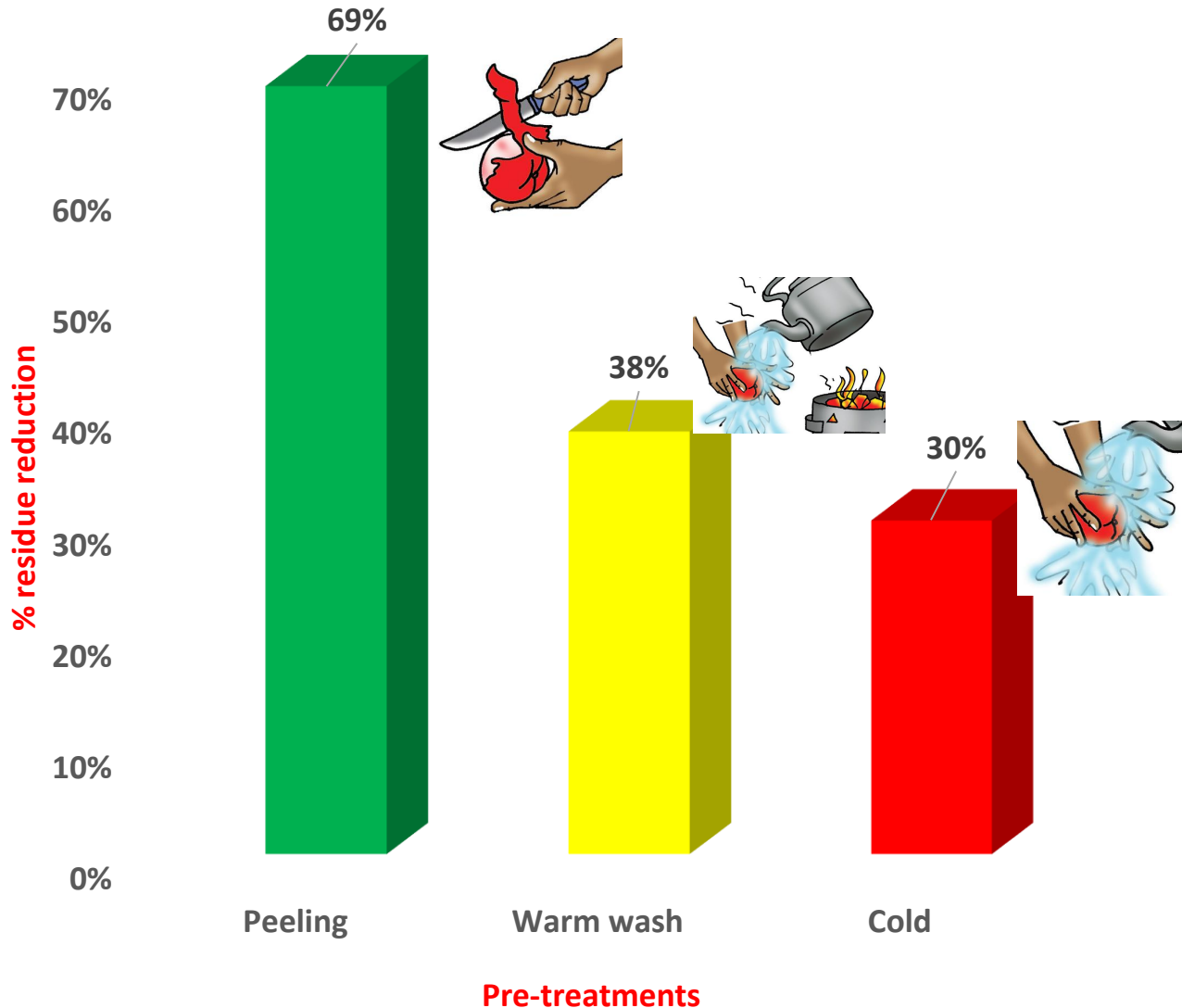


- All the 276 samples had detectable Mancozeb residues
- Max =4.39ppm, Min=0.0034ppm
- Market(152) = 0.95 ± 0.67 ppm
- Farm(124) = 1.27 ± 0.76 ppm
- Difference, Market vs Farm (P=0.000, 95% CI)

- As reported in this study, high levels of Mancozeb in tomatoes have been reported by other researchers (Caldas et al., 2006; Caldas et al., 2011; Kaye et al., 2015; Mehrasbi et al., 2016; Atuhaire et al., 2016, 2017; Skovgaard et al., 2017).
- Food contamination with pesticide residues jeopardizes the safety of consumers and overrides the health benefits of fruits/vegetables consumption.

Pre-treatment effect

Effect of pre-treatments on residue levels



Summary

- Residues were significantly reduced by all the 3 pre-treatments ($P=0.000$, at 95% CI).
- Peeling had the greatest effect (Processing factor=0.31, 69% reduction).
- Effect of warm and cold washing was not significantly different ($P=0.554$, at 95% CI).

- Coherent with this study's findings, other studies from Bolivia (Reiler et al., 2015; Skovgaard et al., 2017), Iran (Mehrasbi et al., 2016), Uganda (Atuhaire et al., 2017) which have demonstrated that processing of fruits and vegetables through practices such as washing and peeling reduces pesticide residues to varying levels.
- Mancozeb is a contact fungicide, hence a bigger proportion of its residues expected in the outer portion of the fruit. Nevertheless this study showed that even the most effective of the used pre-treatments (peeling) did not completely remove the residues.

Maximum Residue Limit

(Codex MRL=2ppm for Dithiocarbamates)

Codex MRL Violation/exceedance

30%
25%
20%
15%
10%
5%
0%

Control

Cold washed

Warm washed

Peeled

Pre-treatment

29%

6%

3%

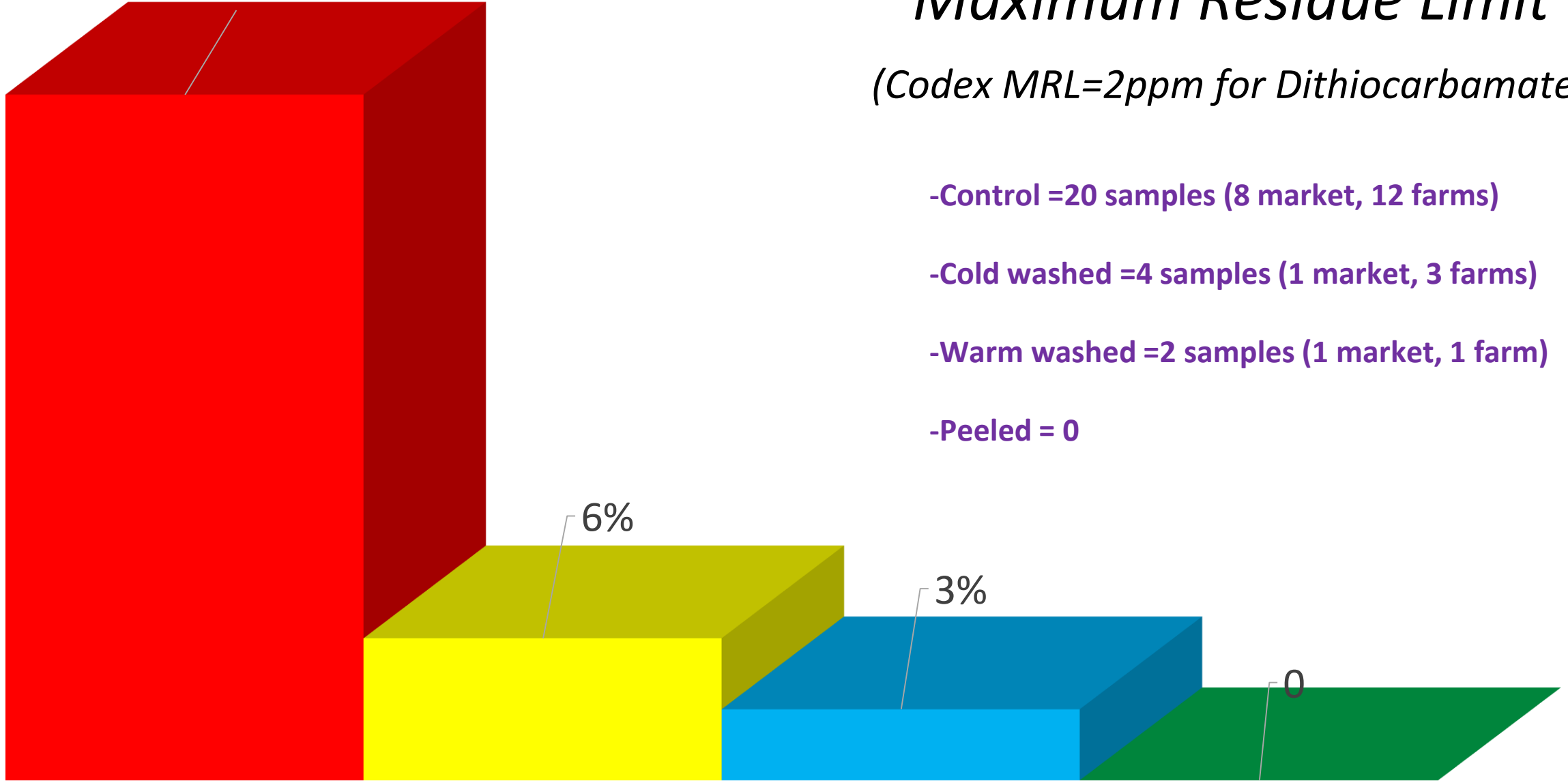
0

-Control =20 samples (8 market, 12 farms)

-Cold washed =4 samples (1 market, 3 farms)

-Warm washed =2 samples (1 market, 1 farm)

-Peeled = 0



- Violation of international food safety standards hurts trade fairness, risks potential trade opportunities and threatens existing trade relations and brings into question the country's commitment to quality assurance

Conclusion

Conventionally grown tomatoes in Uganda contain relatively high residues of the synthetic fungicide, Mancozeb, which unsuspecting consumers are exposed to, though washing with warm water and peeling off the outer skin of the tomato can largely reduce the residue levels.

Recommendations

- This study recommends research institutions (breeding programs) to develop tomato varieties with a relatively longer shelf life (in addition to other consumer desirable attributes).
- There is need for more research into and popularisation of sustainable (ecological/organic) tomato production mechanisms that will guarantee safe produce for consumption.
- A functional national pesticide residue surveillance program for Uganda is recommended as a means towards safety of consumers in the country and beyond.



Thanks!

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