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1 - 3 November 2021

Pesticide residue trends in fruits and vegetables from farm to fork in Kampala Metropolitan Area, Uganda – A mixed methods study

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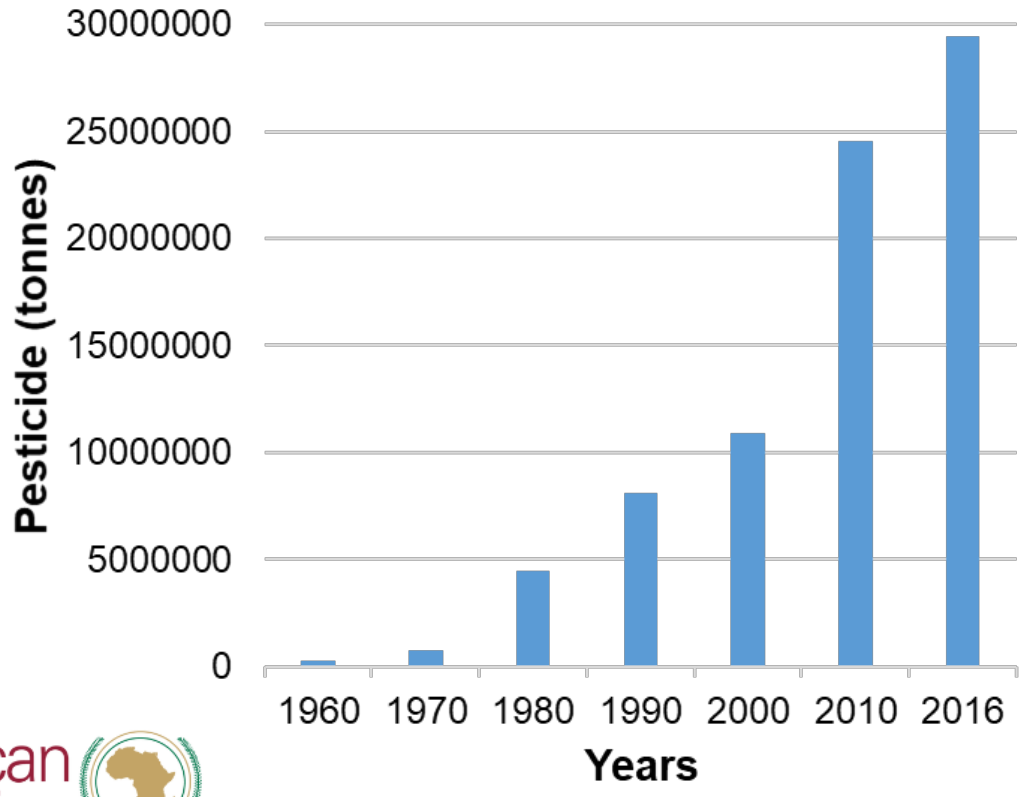
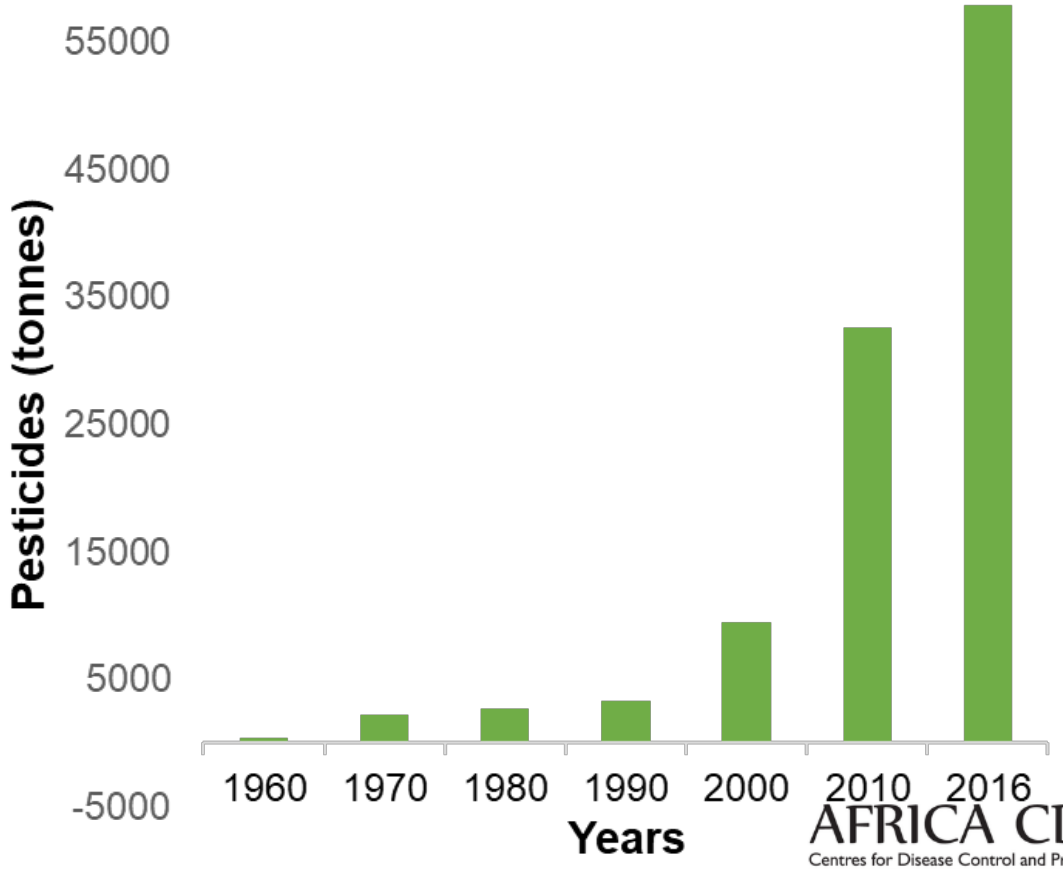
Global and Nation pesticide use trends

Global Trends of Pesticide Use for Agriculture



Trends of pesticides use for agriculture in Uganda



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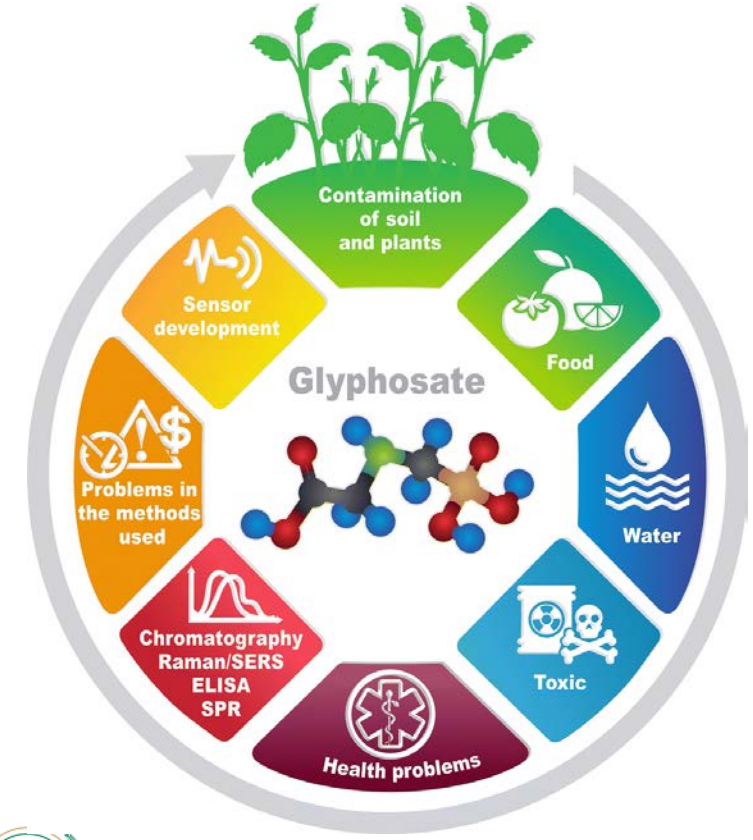
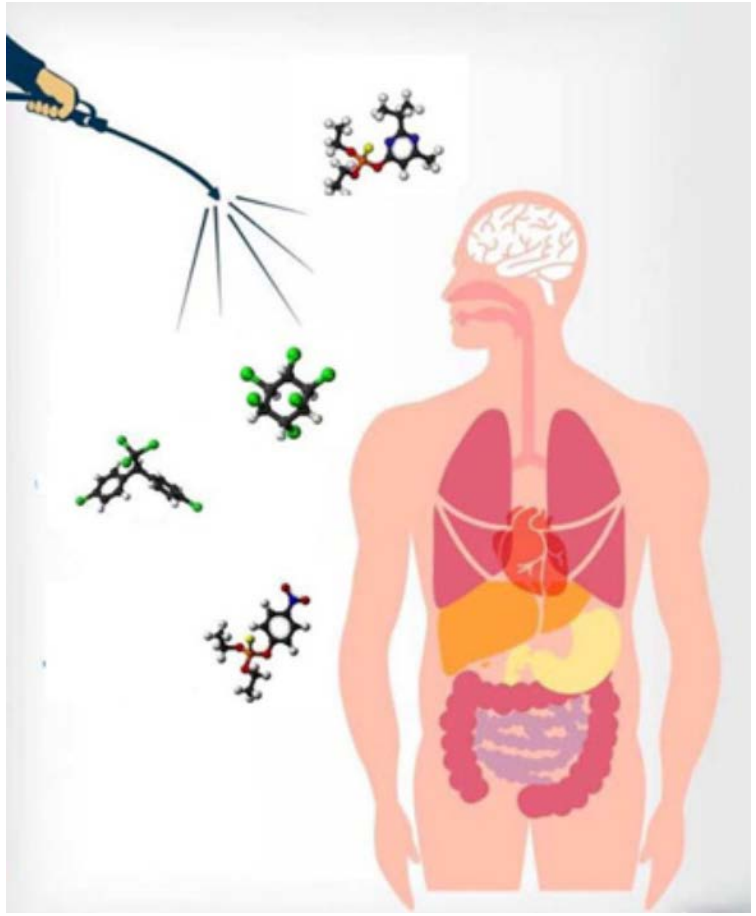
What do we know about pesticides?

Fate of pesticide in the environment



Human health effects



Acute health effects

- Inhibition of blood clotting
- Paralysis of respiratory and circulatory system

Chronic Health effects

- Cancers
- Reproductive defects
- Neurodevelopment defects
- Increased reaction time
- Impaired mental development

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Pesticide use in Uganda

- A significant percentage of pesticides are used for fruits and vegetable production to control pests and diseases.
- Pesticides use without following the good agricultural practices (GAPs).
- Pesticide tend accumulate on fruits and vegetables as residues.
- Pesticide residues in food is the main means of exposure to pesticides in the general population.
- With the non-communicable diseases (NCDs) surge, intake of fruits and vegetables as a preventive measure for these diseases is on a rise.
- This exposes fruits and vegetables consumers to pesticides through ingesting their residues.

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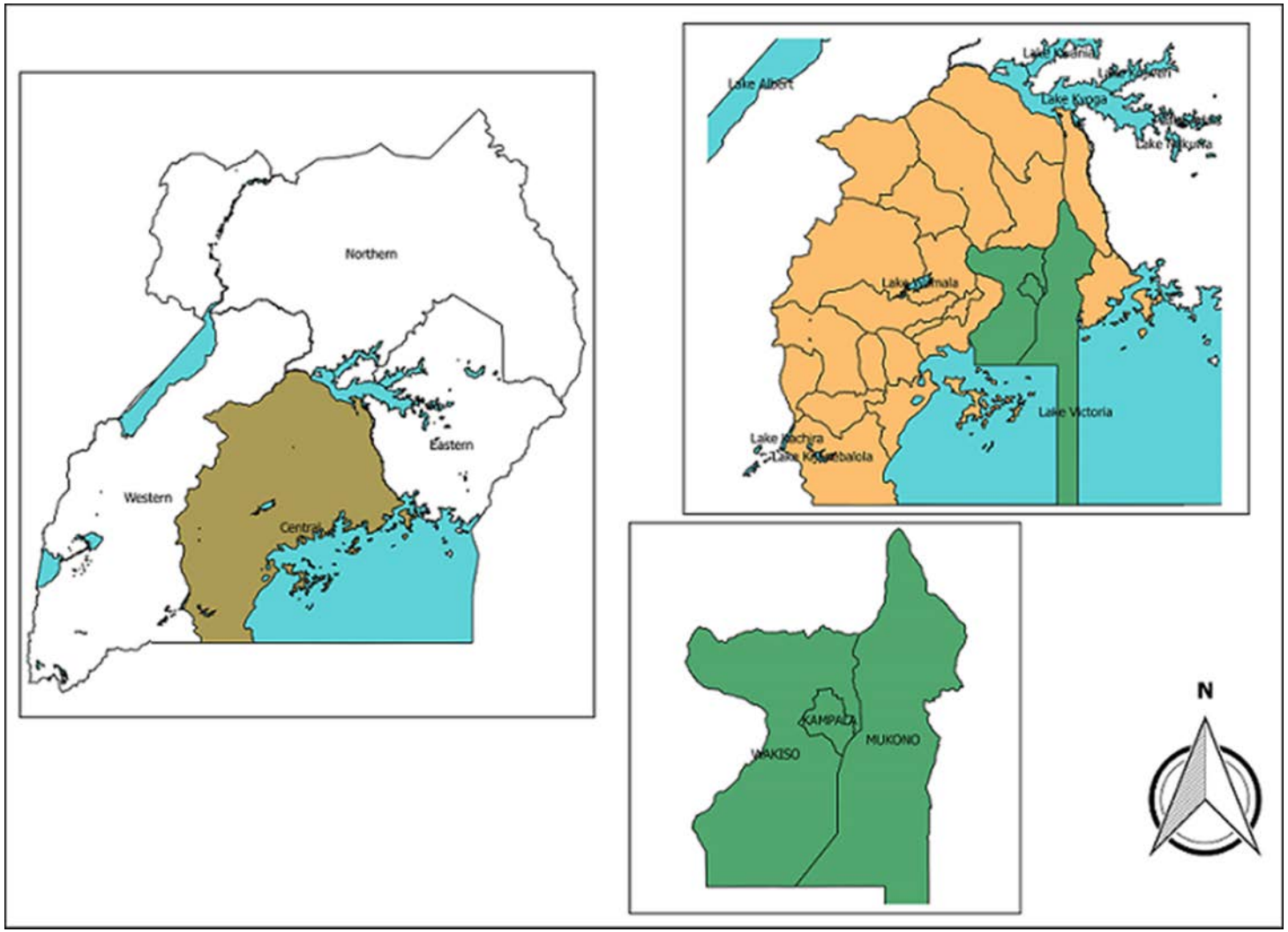
Study objective

To examine pesticide residue trends and stakeholders' handling and processing practices for fruits and vegetables from farm to fork in the Kampala Metropolitan area in Uganda.

Methods – Study Area



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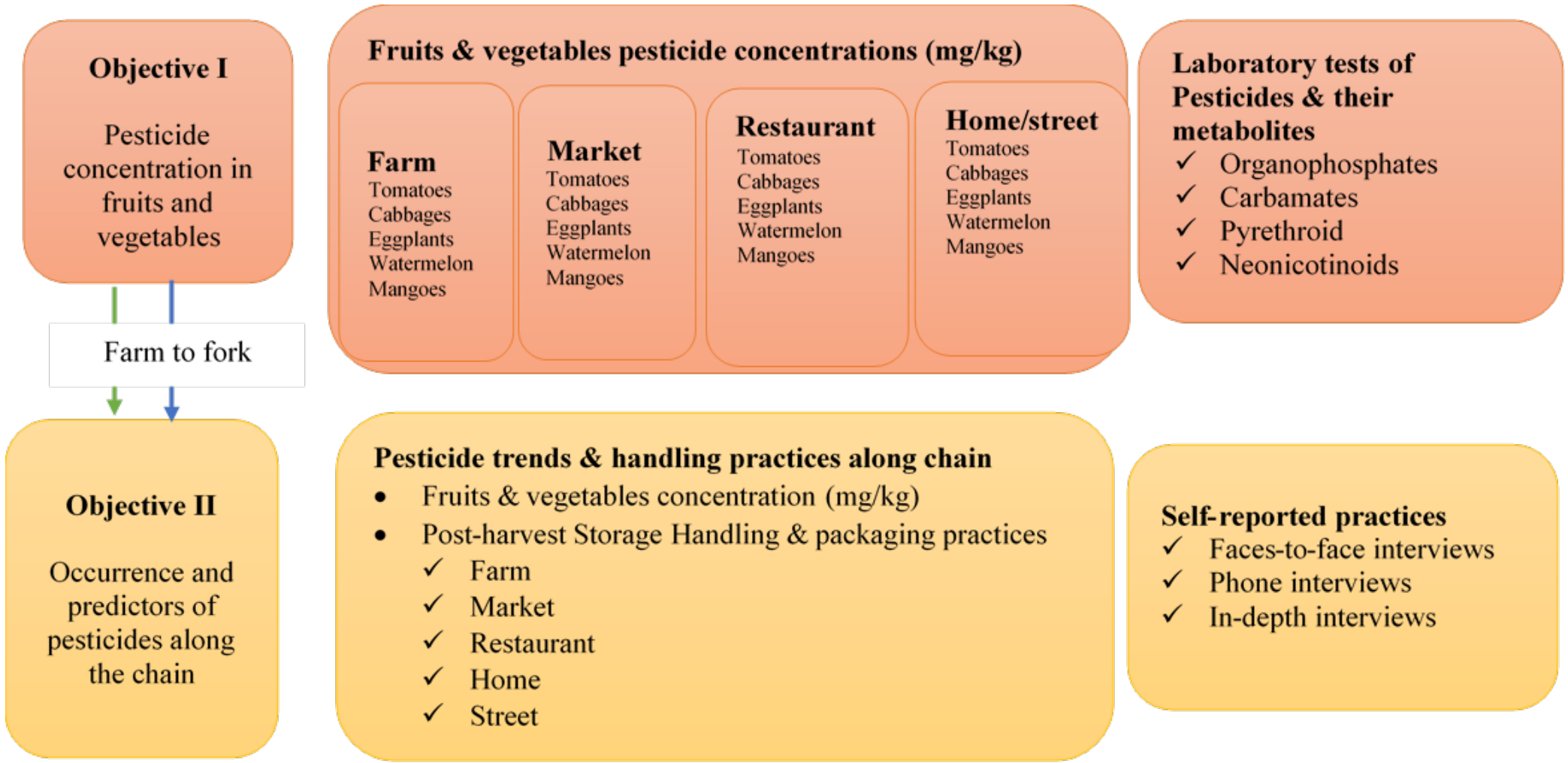
Mixed methods



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Data analysis

- **QUANT**
- Summary statistics with frequencies, means, median and interquartile ranges.
- Nptrend test
- **QUAL**
- Conventional content analysis
  - Coded
  - Merged related codes to form subthemes
  - Subthemes grouped to overarching themes

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Classes of pesticides residues detected

Chemical family of pesticide	Frequency (n = 160)	Percentage (%)
Organophosphates	146	91.3
Carbamates	108	67.5
Pyrethroids	96	60.0
Dithiocarbamates	77	48.1
Neonicotinoids	68	42.5
Chloroacetamide	40	25.0
Anilinopyrimidine	38	23.8
Pyrimidine	35	21.9
Imidazole	34	21.3
Tetramic acid	20	12.5
Benzoylurea	17	10.6
Benzimidazole	16	10.0
Triazole	15	9.4
Hydroxyanilide	11	6.9
Quinoline	10	6.3
Quinazolinone	6	3.8
Strobilurin	5	3.1
Aryloxyphenoxypropionate	4	2.5
Phenylamide	2	1.3
Isoxazolidinone	1	0.6

Multiple Pesticides Residues in Samples

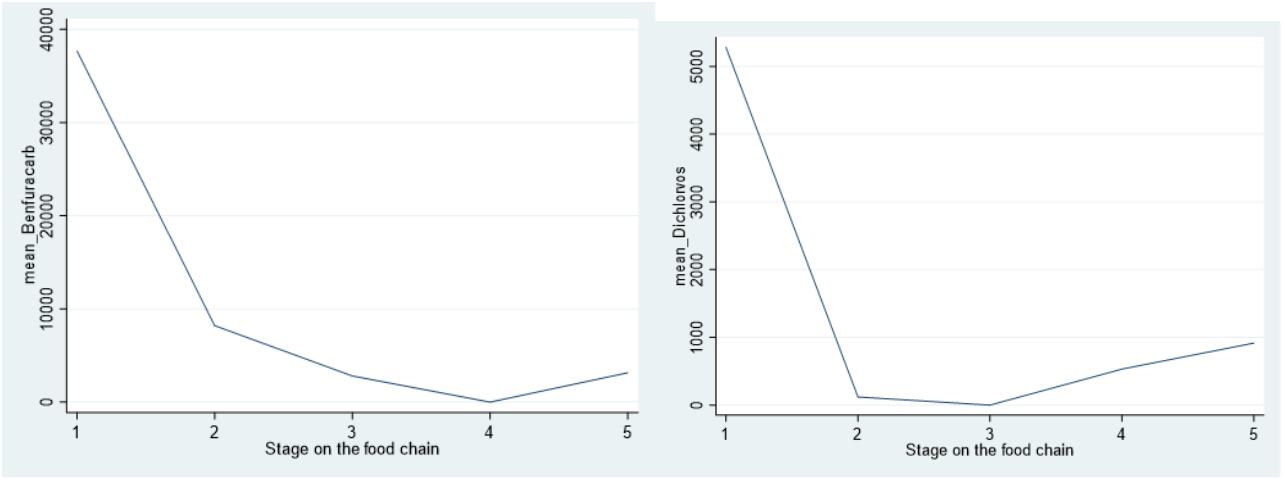
# of pesticide residues	Farm (N=50)	Market (N=50)	Restaurant (N=20)	Street (N=20)	Home (N=20)	Total (N=160)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
1	0 (0.0)	1 (2.0)	1 (5.0)	1 (5.0)	4 (20.0)	7 (4.4)
2	2 (4.0)	4 (8.0)	2 (10.0)	2 (10.0)	1 (5.0)	11 (6.9)
3	4 (8.0)	4 (8.0)	2 (10.0)	1 (5.0)	1 (5.0)	12 (7.5)
4	9 (18.0)	1 (2.0)	2 (10.0)	3 (15.0)	3 (15.0)	18 (11.3)
5	3 (6.0)	12 (14.0)	2 (10.0)	1 (5.0)	0 (0.0)	18 (11.3)
6	2 (4.0)	4 (8.0)	1 (5.0)	3 (15.0)	0 (0.0)	10 (6.3)
7	4 (8.0)	3 (6.0)	0 (0.0)	0 (0.0)	1 (5.0)	8 (5.0)
8	10 (20.0)	3 (6.0)	0 (0.0)	4 (20.0)	1 (5.0)	18 (11.3)
9	3 (6.0)	1 (2.0)	1 (5.0)	1 (5.0)	1 (5.0)	7 (4.4)
10	5 (10.0)	1 (2.0)	1 (5.0)	0 (0.0)	3 (15.0)	10 (6.3)
11	3 (6.0)	6 (12.0)	1 (5.0)	1 (5.0)	0 (0.0)	11 (6.9)
12	1 (2.0)	1 (2.0)	4 (20.0)	0 (0.0)	0 (0.0)	6 (3.8)
13	1 (2.0)	4 (8.0)	0 (0.0)	0 (0.0)	2 (10.0)	7 (4.4)
14	2 (4.0)	3 (6.0)	0 (0.0)	2 (10.0)	1 (5.0)	8 (5.0)
15	1 (2.0)	2 (4.0)	0 (0.0)	0 (0.0)	2 (10.))	5 (3.1)
16	0 (0.0)	0 (0.0)	2 (10.0)	0 (0.0)	0 (0.0)	2 (1.3)
19	0 (0.0)	0 (0.0)	1 (5.0)	1 (5.0)	0 (0.0)	2 (1.3)
Total	50 (100)	50 (100)	20 (100)	20 (100)	20 (100)	160 (100)

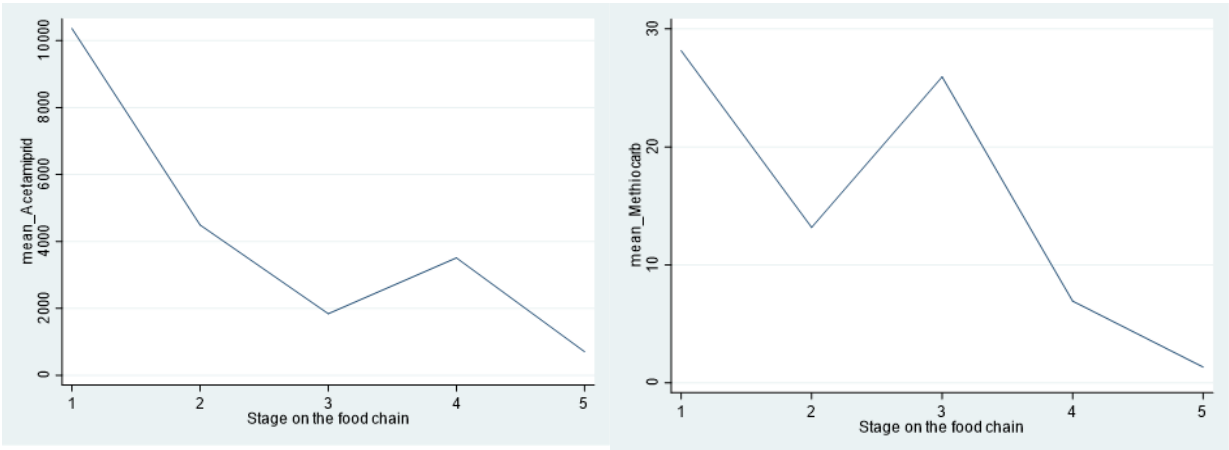
Pesticide active ingredient	Percentage (%)
Propetamophos	48.5
Lambda-Cyhalothrin	40.0
Acephate	32.5
Imidacloprid	30.0
Fenofos	28.8
Metazachlor	25.0
Pyrimethanil	23.8
Monocrotophos	21.9
Fenarimol	21.9
Imazalil	21.3
Methomyl	21.3
Aminocarb	20.6
Cypermethrin	20.6
Bifenthrin	19.4
Pirimicarb	19.4
Dichlorvos	18.8
Acetamiprid	18.8

Banned for agricultural use

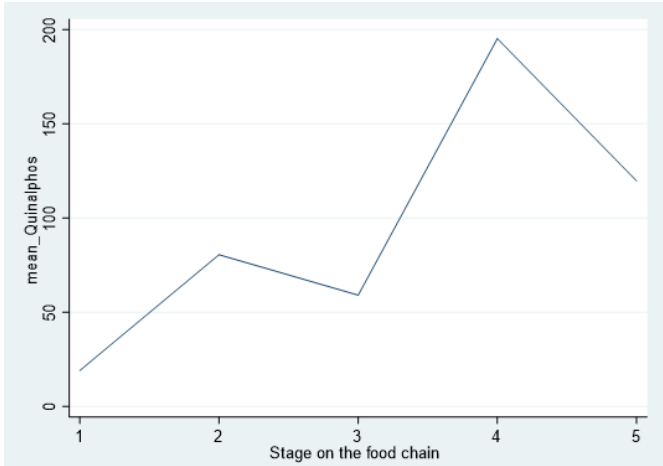
Trends of pesticide residues from farm to fork

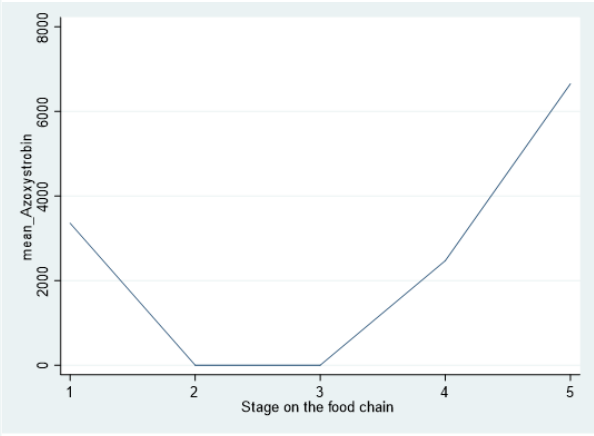
Decreasing trends (18 pesticides)

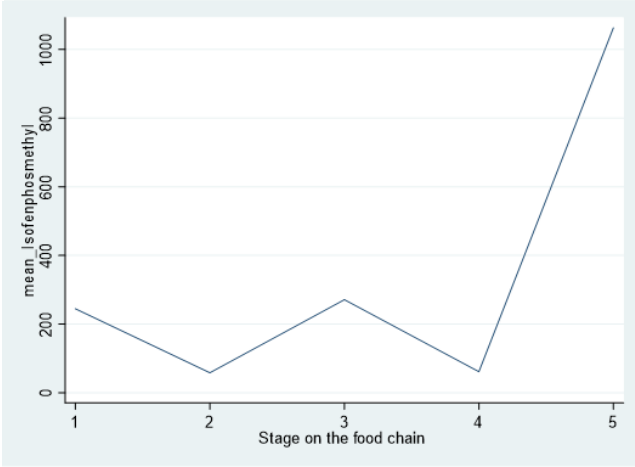


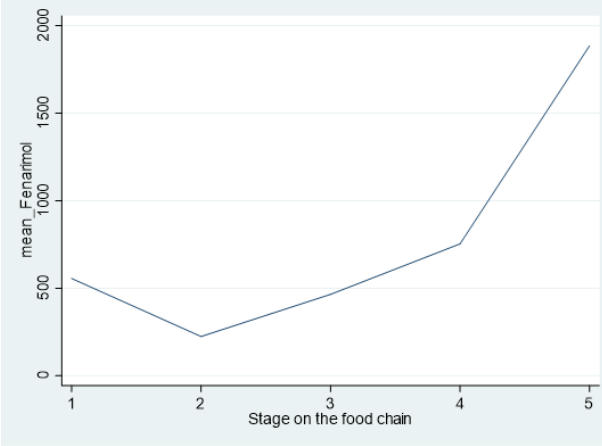


Increasing trends (9 pesticides)









Pesticides residue trends from farm-to-fork

Pesticide residue	LOD (ng/kg)	Farm	Market	Street	Restaurant	Home	p-value
		Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
Mevinphos	33.9	25.7±129.0	34.9±147.9	3.7±14.3	3.6±12.4	14.4±64.3	0.20
Dichlorvos	15.3	6448.5±22252.2	126.5±387.4	56.1±147.7	265.8±960.5	504.9±1128.8	0.81
Profenofos	9.7	18196.7±75391.2	7106.6±37302.2	6328.9±19767.4	10879.2±29572.2	722.2±2570.4	0.75
Methomyl	33.5	35.8±84.8	52.9±117.0	7.1±26.9	39.2±103.6	4.6±20.1	0.14
Dioxacarb	13.1	5273.9±17656.2	4068.9±15284.1	3462±15484.2	0	0	0.01*
Methiocarb	43.9	28.2±74.7	13.2±37.9	25.9±48.0	6.9±18.9	1.3±3.1	0.61
Acetamiprid	20.4	6626.5±24394.5	3561.2±11552.9	2349.4±4791.9	2235.2±5549.1	810.6±2518.5	0.91
Bifenthrin	18.7	113.3±392.4	258.3±1018.4	7.5±33.6	26.8±68.7	4.2±13.1	0.11
Benfuracarb	50.0	37668.5±175456.4	8207.5±29972.8	2802±5206.2	8.1±2.6	3146.6±9950.6	0.71
Lambda-Cyhalothrin	21.1	167.7±389.7	189.4±423.8	198.6±353.2	126.1±234.4	149.9±242.2	0.45
Cypermethrin	11.1	736.7±2883.3	314.0±1122.9	808.4±2792.7	172.3±493.9	100.1±348.2	0.92
Spirotetramat	18.4	45.8±192.0	25.2±97.3	39.1±92.9	5.1±11.2	15.6±28.8	0.90
Flufenoxuron	15.4	5.8±26.6	3.5±13.0	0.3±1.6	2.2±7.9	0.9±4.1	0.49
Proquinazid	14.6	540.2±1767.2	121.4±606.8	427.0±1350.4	168.7±533.5	0	0.41
Methidathion	14.4	0	0	1.9±6.0	0	39.8±110.9	0.01*
Carbaryl	7.7	4.3±27.6	4.2±49.9	2.9±12.8	0	15.5±49.9	0.94
Azoxystrobin	7.4	3356.1±11900.6	0	0	2472.4±5931.1	6652.6±21037.3	0.35
Fenarimol	13.1	347.5±1092.0	139.7±612.9	255.5±659.7	382.9±1051.6	942.4±2494.6	0.88
Isofenphosmethyl	20.0	244.8±611.0	58.3±219.5	271.3±857.9	61.3±193.8	1063.5±1743.2	0.31
Ethoprophos	84.6	0	16.5±82.7	0	15.5±49.1	44.4±140.5	0.11

Movement of fruits and vegetables along chain

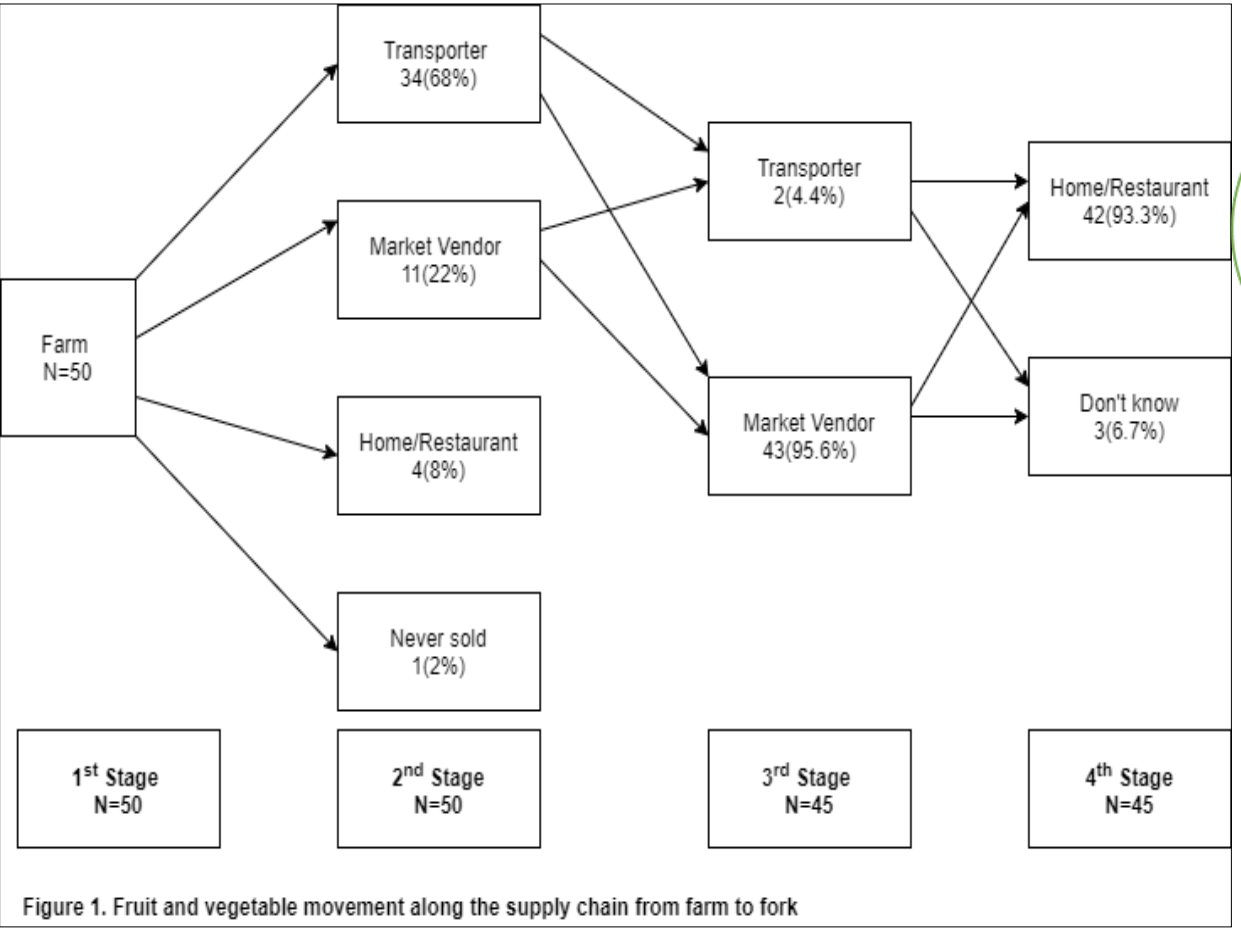
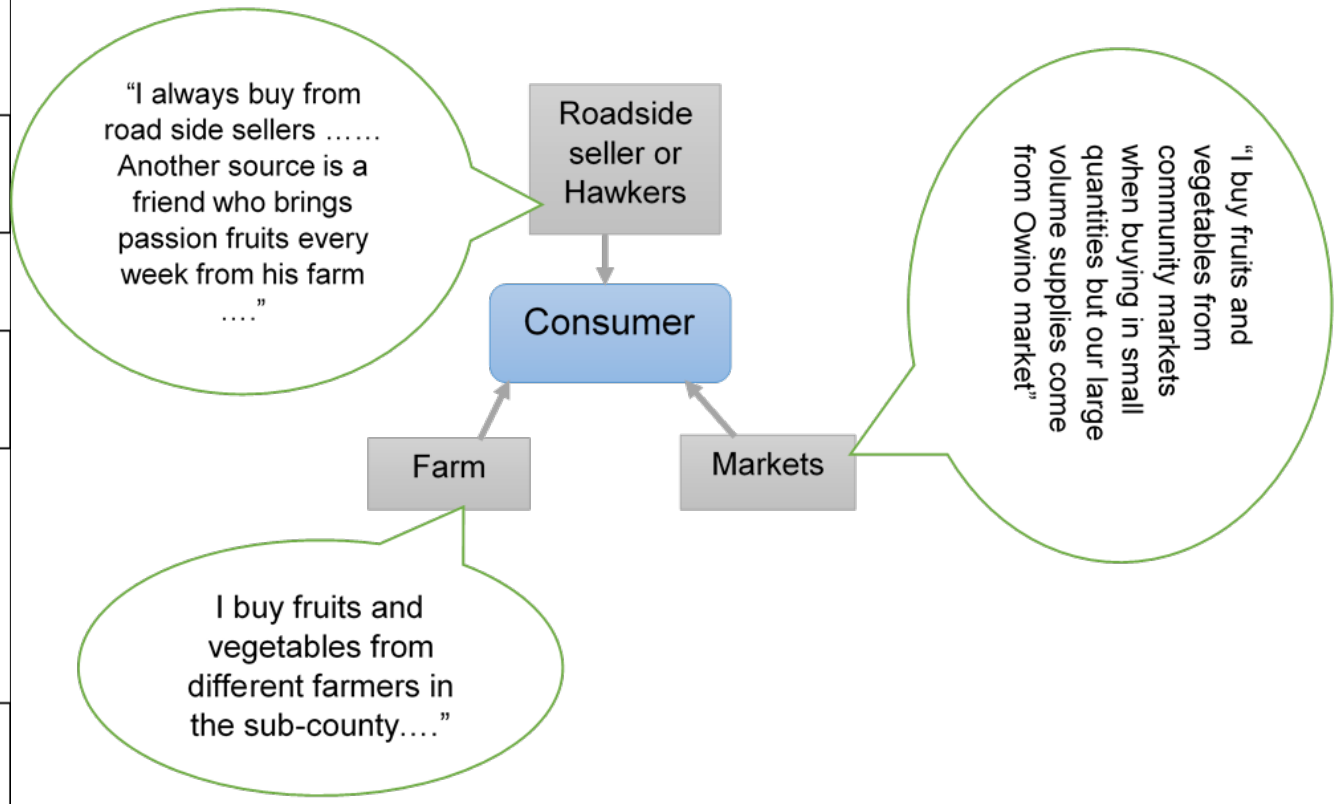
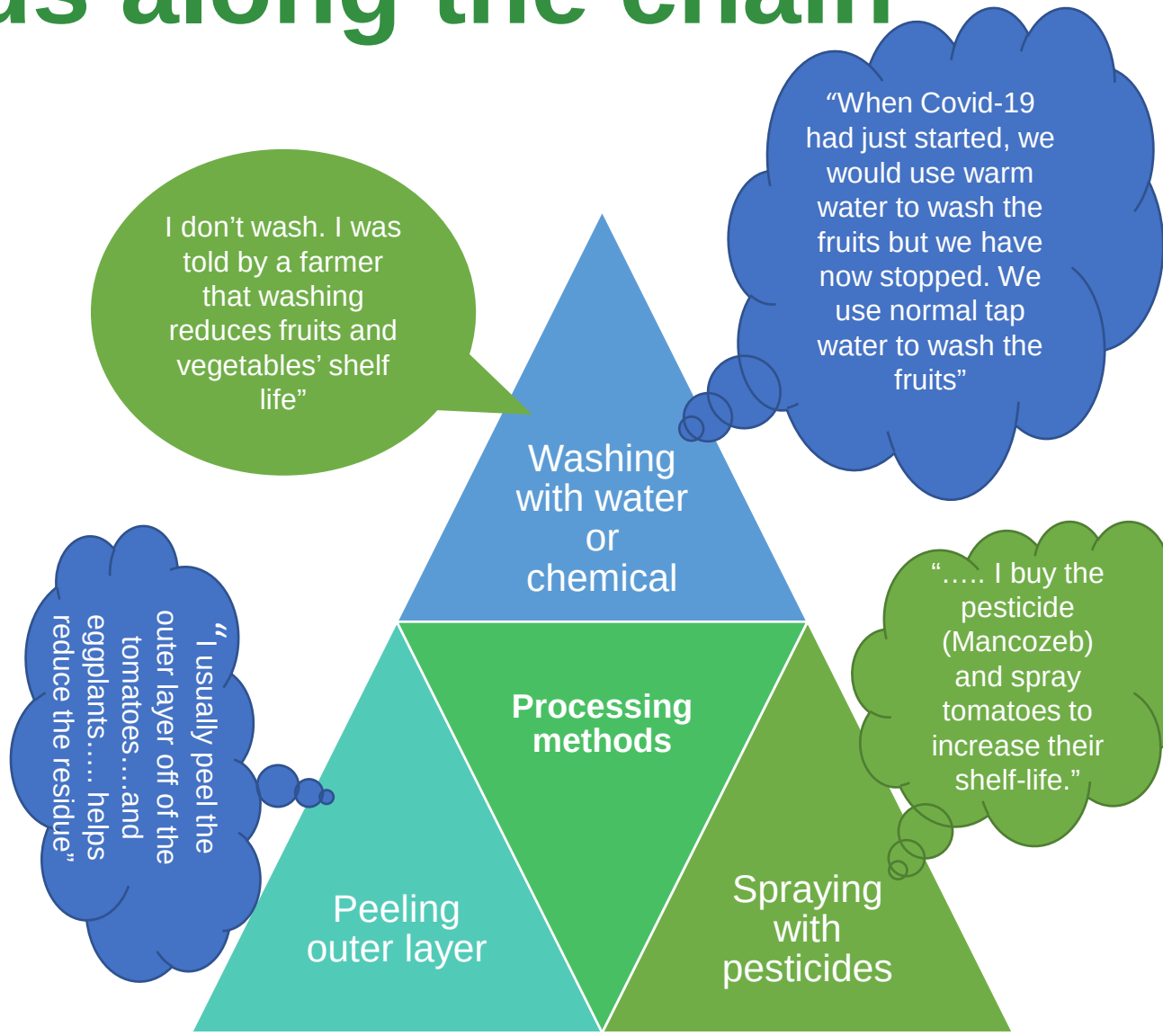


Figure 1. Fruit and vegetable movement along the supply chain from farm to fork



Processing methods along the chain

Variable	Farm	Transporter	Market vendor	Consumer
	n(%)	n(%)	n(%)	n(%)
Wash with water	2(4)	00(00.0)	5(10.0)	41(82.0)
Wash with chemical	00(00.0)	00(00.0)	00(00.0)	00(00.0)
Peel off outer layer	5(10)	3(6.0)	3(6.0)	10(20.0)
Spray with pesticide	00(00.0)	00(00.0)	00(00.0)	00(00.0)
Sun drying	00(00.0)	00(00.0)	00(00.0)	00(00.0)
Cooking	00(00.0)	00(00.0)	00(00.0)	21(42.0)
Boiling	00(00.0)	00(00.0)	00(00.0)	4(8.0)
Oven drying	00(00.0)	00(00.0)	00(00.0)	00(00.0)
Nothing	43(86)	28(56.0%)	36(72.0)	00(00.0)



Study Limitations

- Information bias.
- Pesticide concentrations measured in selected fruits and vegetables and not the broad spectrum.
- Panel sampling of fruits and vegetables along the chain.

Conclusion

- Fruits and vegetables on the local market are heavily contaminated with pesticide residues.
- Concentration of pesticide residues increase and decrease along the chain suggesting contamination along the chain.
- Consumers in KMA are at risk of health effects associated with dietary exposure to pesticides.
- Promote sustainable agricultural methods.
- Establish routine monitoring and surveillance systems for pesticide residues in food.

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THANK YOU

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