AFRIMETS
Intra-Africa Metrology System
Système Intra-Africain de Métrologie

An Overview of the Pan African Food Safety Testing Capacity Survey 2022

Maria Fernandes-Whaley
National Metrology Institute of South Africa (NMISA)
19 October 2023

Implementation began in 2020

Add $450bn to the economy (2035)

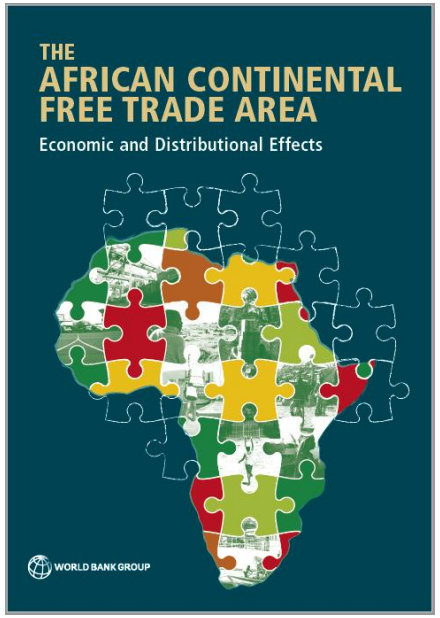
Total Exports 29%↗

Intra-continental Exports 81%↗

Non-African Exports 19%↗

30 million out of extreme poverty

Creating One African Market



55 member states

POPULATION:

1.2 billion (70% below age 30)

POTENTIAL MARKET SIZE:

$ 3.4 trillion

(GDP, Tralac, 2020)

Source: World Bank Group Report, 27 July 2020

AFRIMETS
Intra-Africa Metrology System
Système Intra-Africain de Métrologie

The Food Safety Strategy for Africa 2022-2036

Goal:

Contribute to improved public health, food and nutrition security, sustainable livelihoods and economic growth

Outcomes:

- Enhanced consumer protection
- Increased safe food trade

Strategic Objectives: Strengthen capacity to manage food safety risks along the food value chain

- SO1: Strengthen food safety policy, legal and institutional frameworks
- SO2: Strengthen the human and infrastructure capacity for food control systems
- SO3: Promote food safety culture, evidence-based advocacy, communication, information and knowledge sharing to raise consumer awareness and empowerment
- SO4: Improve trade and market access at national, regional, continental and global levels
- SO5: Strengthen research, innovation, technology development and transfer
- SO6: Establish and strengthen coordination mechanisms and enhance cooperation at national, regional, continental and global levels

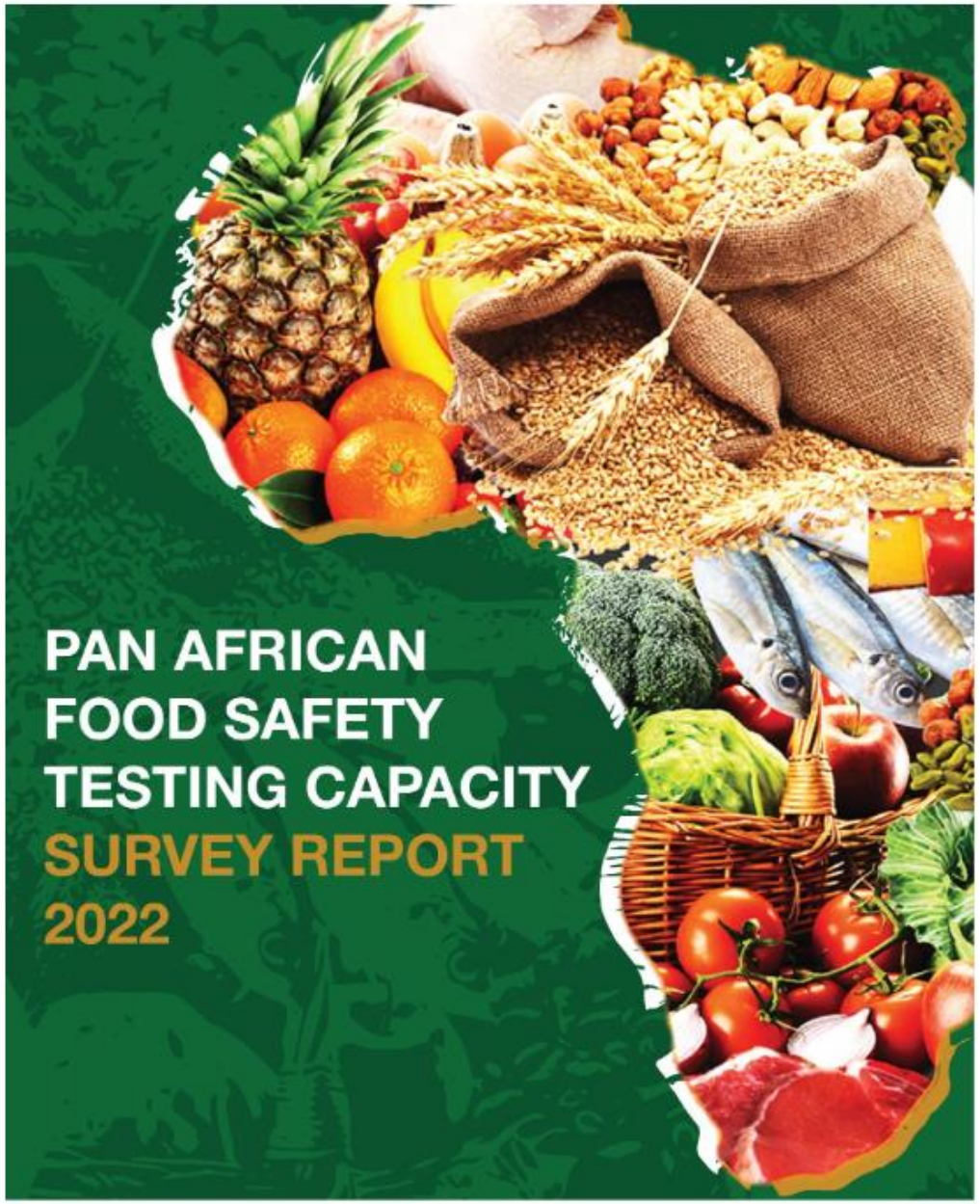
The AFRIMETS initiative is supported by

german cooperation
DEUTSCHE ZUSAMMENARBEIT

PTB
Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

AFRIMETS
Intra-Africa Metrology System
Système Intra-Africain de Métrologie

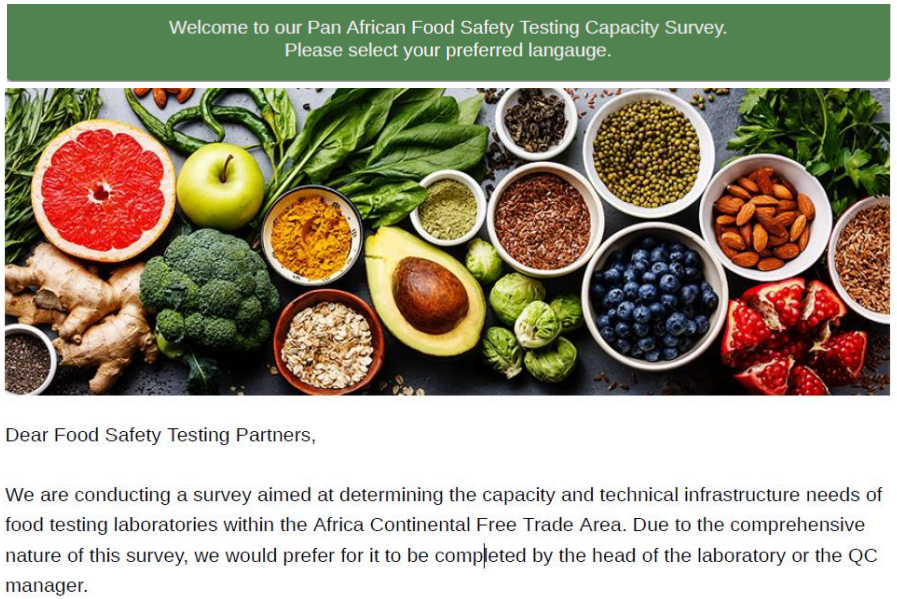
- Within AfCFTA, the risk to the food supply chain will be increased through frictionless trade between countries, necessitating the strengthening of local testing capabilities.
- **2021**: AFRIMETS, proposed a food testing capacity-building project divided into 2 phases.
- **2022**: Phase 1: Pan African Survey to assess the food safety testing capacity within the AfCFTA, identify gaps and challenges
- **2023**: Phase 2: Training

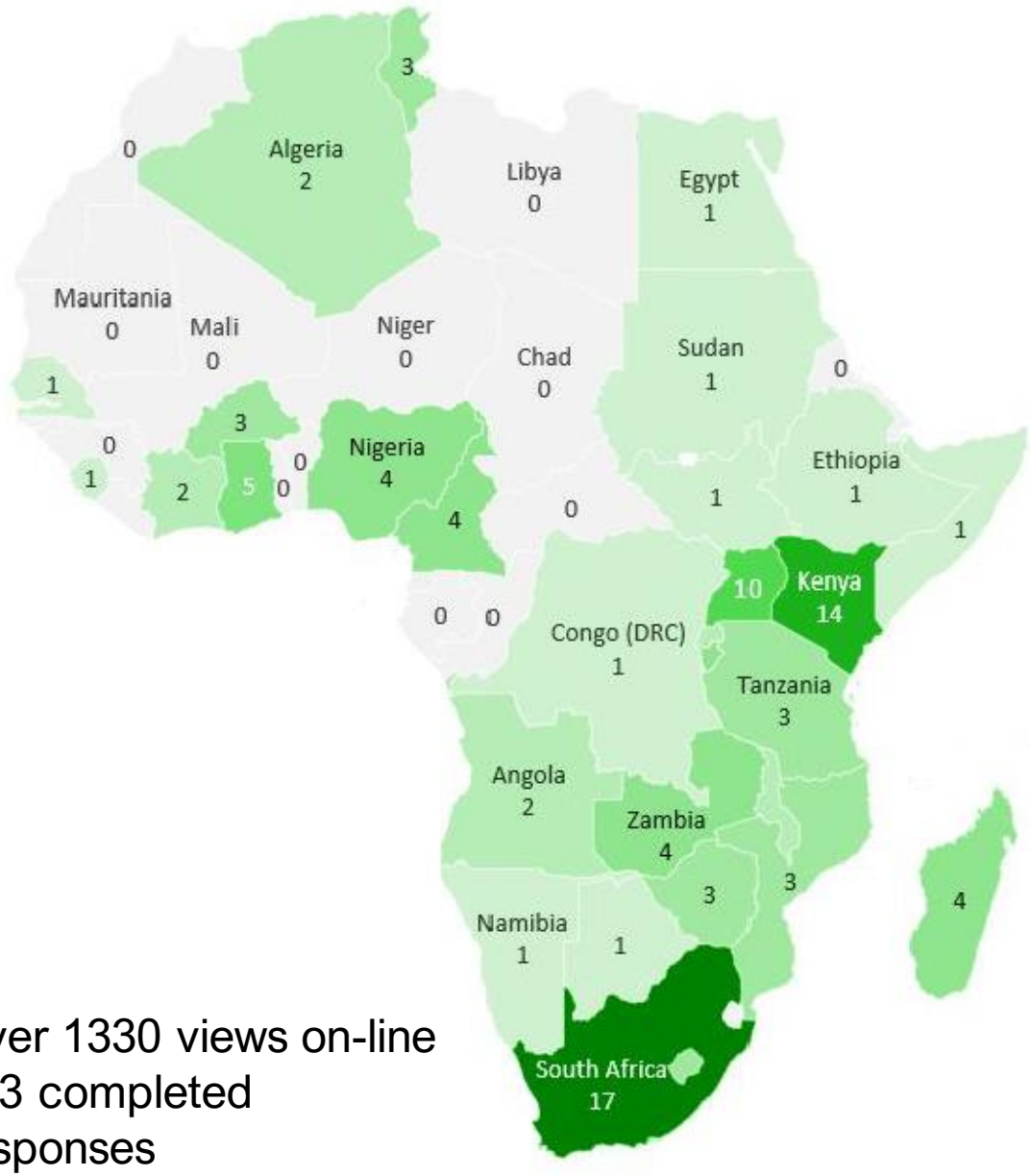


AFRIMETS Survey Report is available at
http://www.afrimets.org/SitePages/Home.aspx

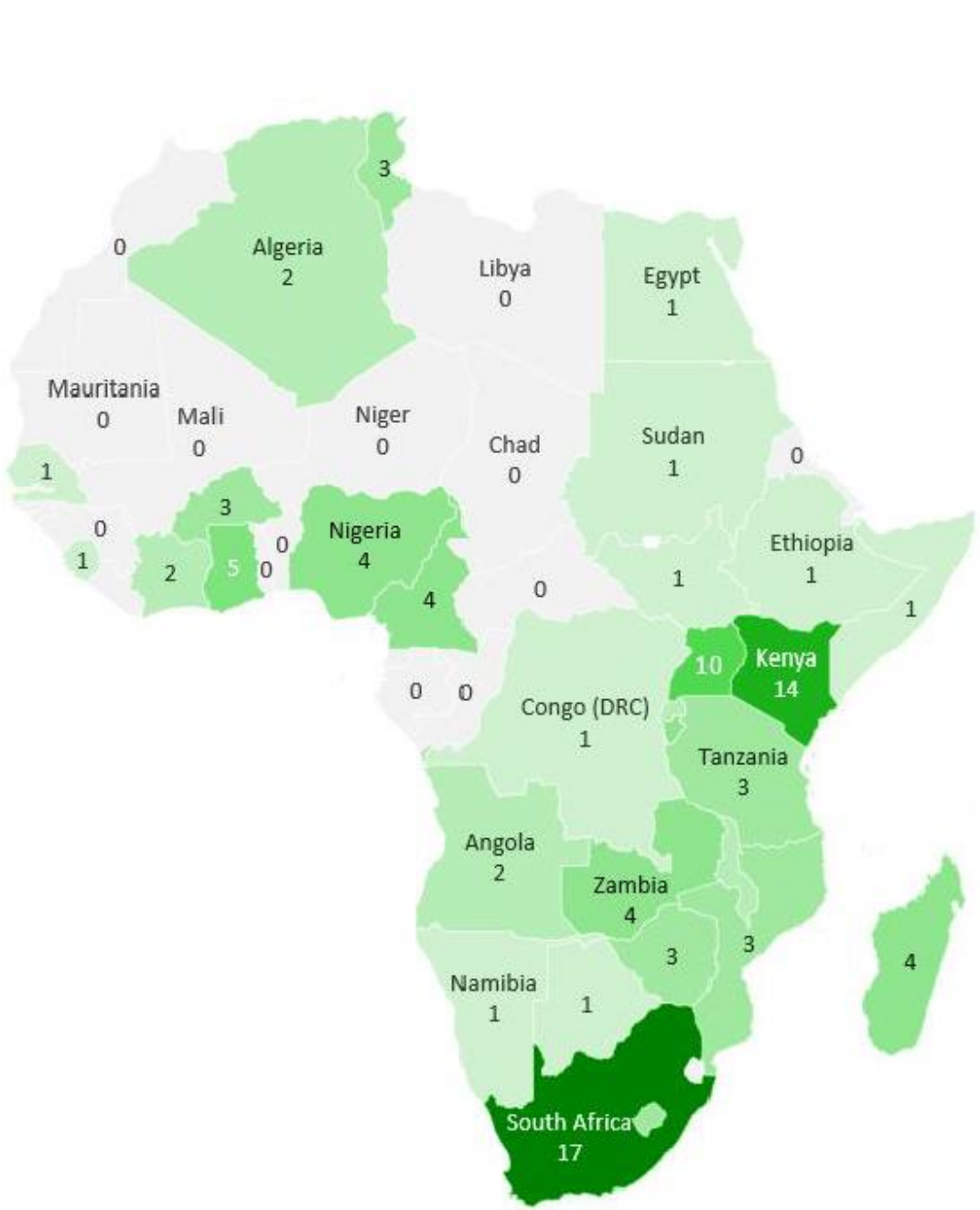
Survey Approach

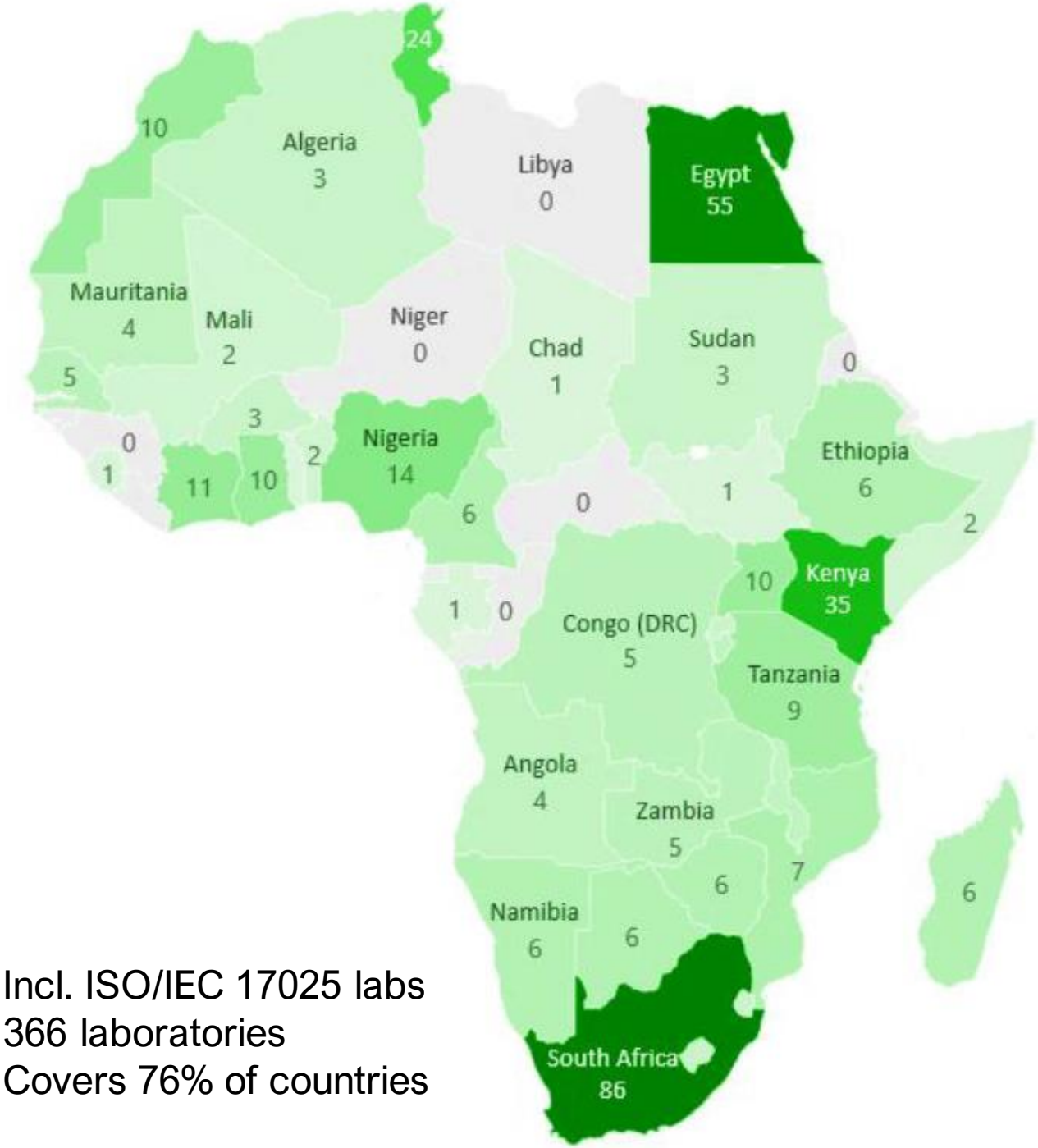
- Coordinated by NMISA
- Training needs and staff qualification profiles
- Instrumentation, automation and LIMS
- Access to PT and reference materials
- Accreditation and Quality Systems
- General laboratory operational challenges
- Participation in food monitoring programmes
- Testing services (current/ planned)
- Foodstuff categories
- Volumes of samples analysed and client demographics
- Gap score; the difference between country need and the degree of implementation
- SurveyLab™, on-line platform used that allows for easy access by participants through desktop PCs or mobile phones, only requiring internet access
- Available in English, French and Portuguese





- Over 1330 views on-line
- 113 completed responses
- Covers 60% of countries





- Incl. ISO/IEC 17025 labs
- 366 laboratories
- Covers 76% of countries

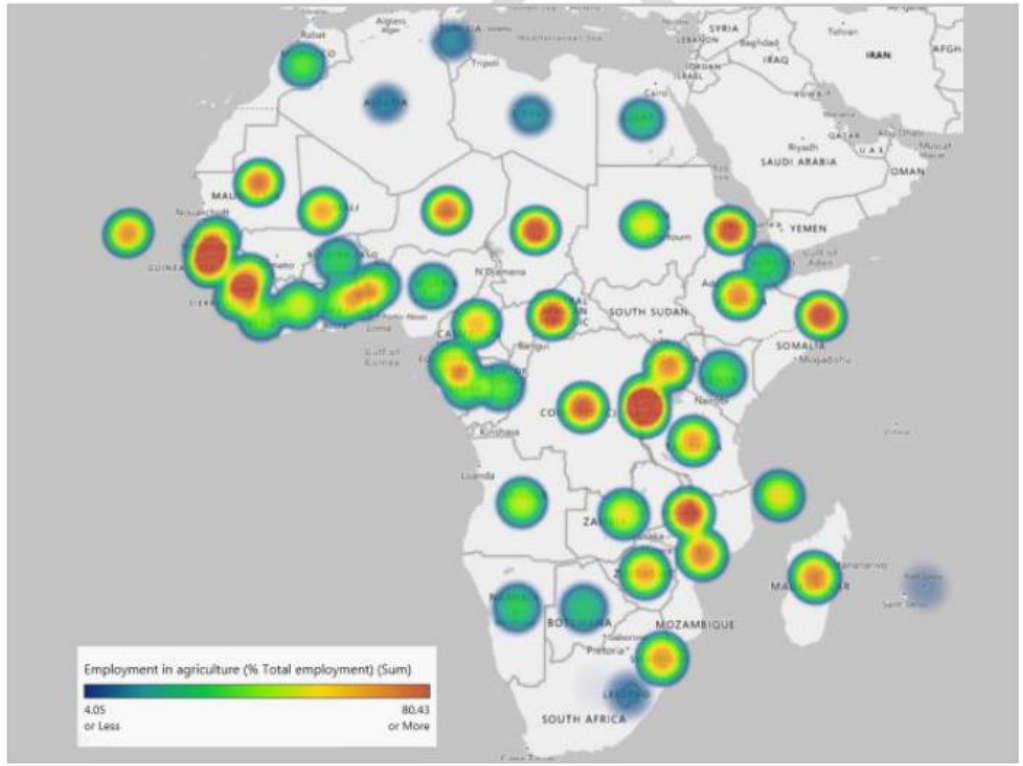
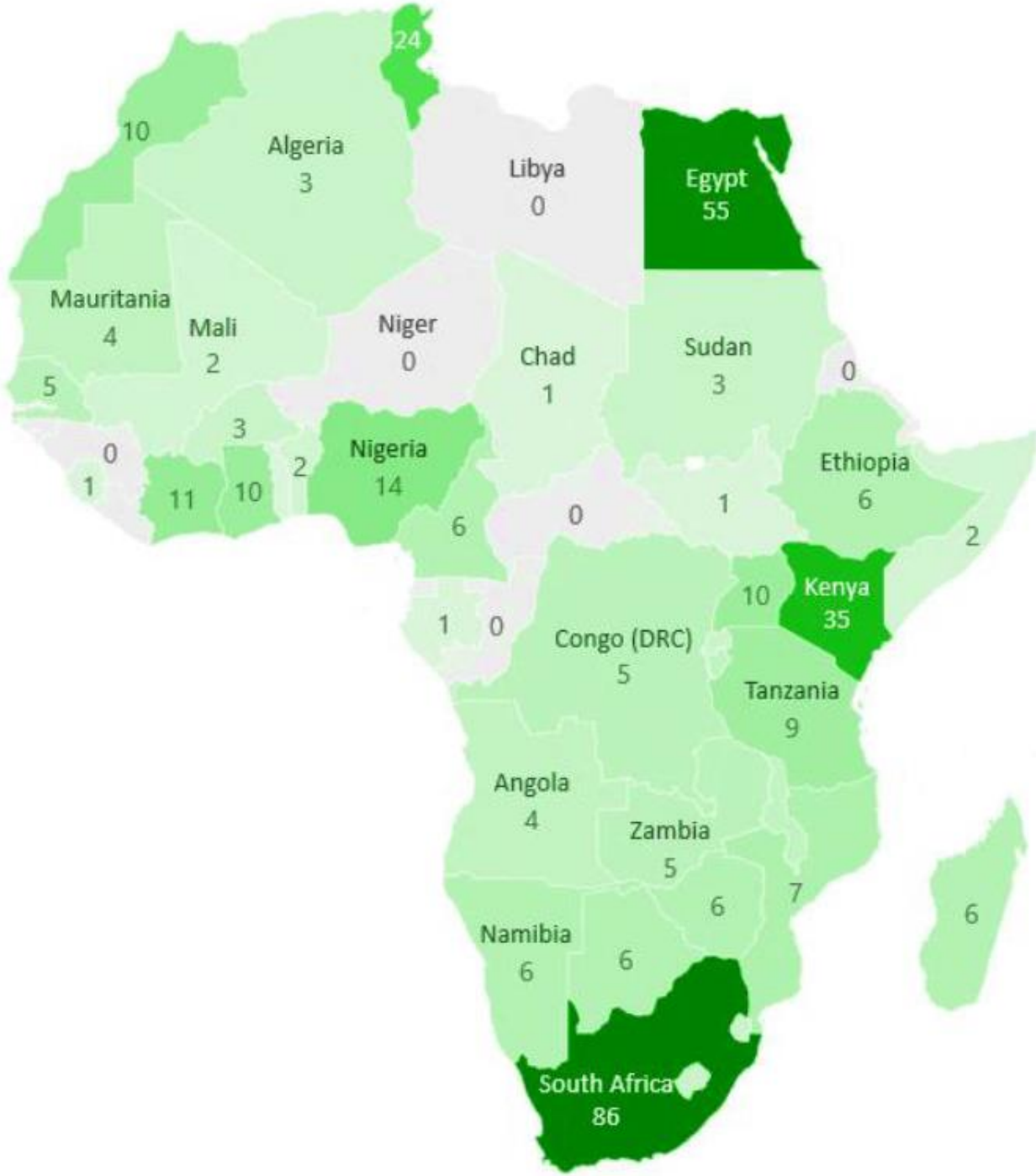


Figure 1 E: Percentage of total employment in the African Agricultural Sector



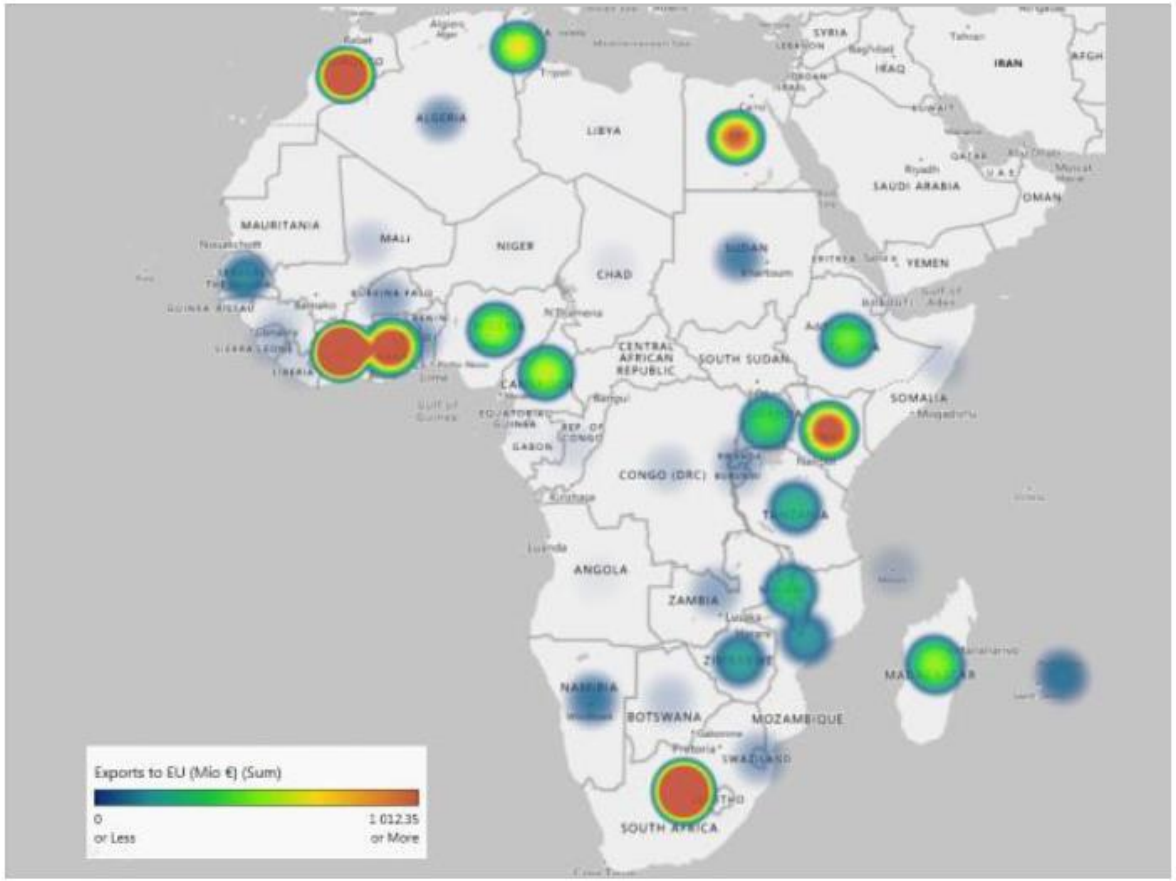
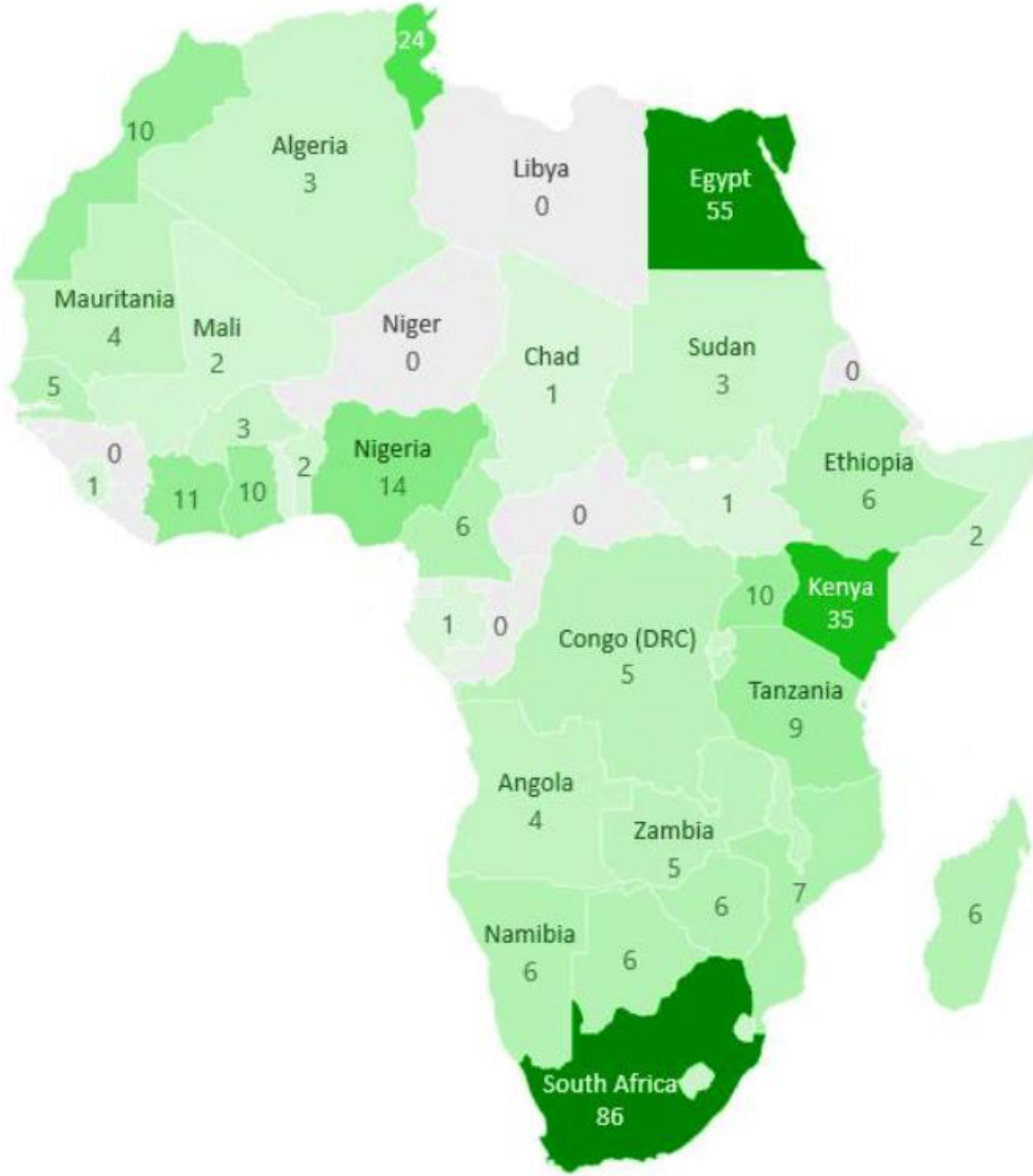
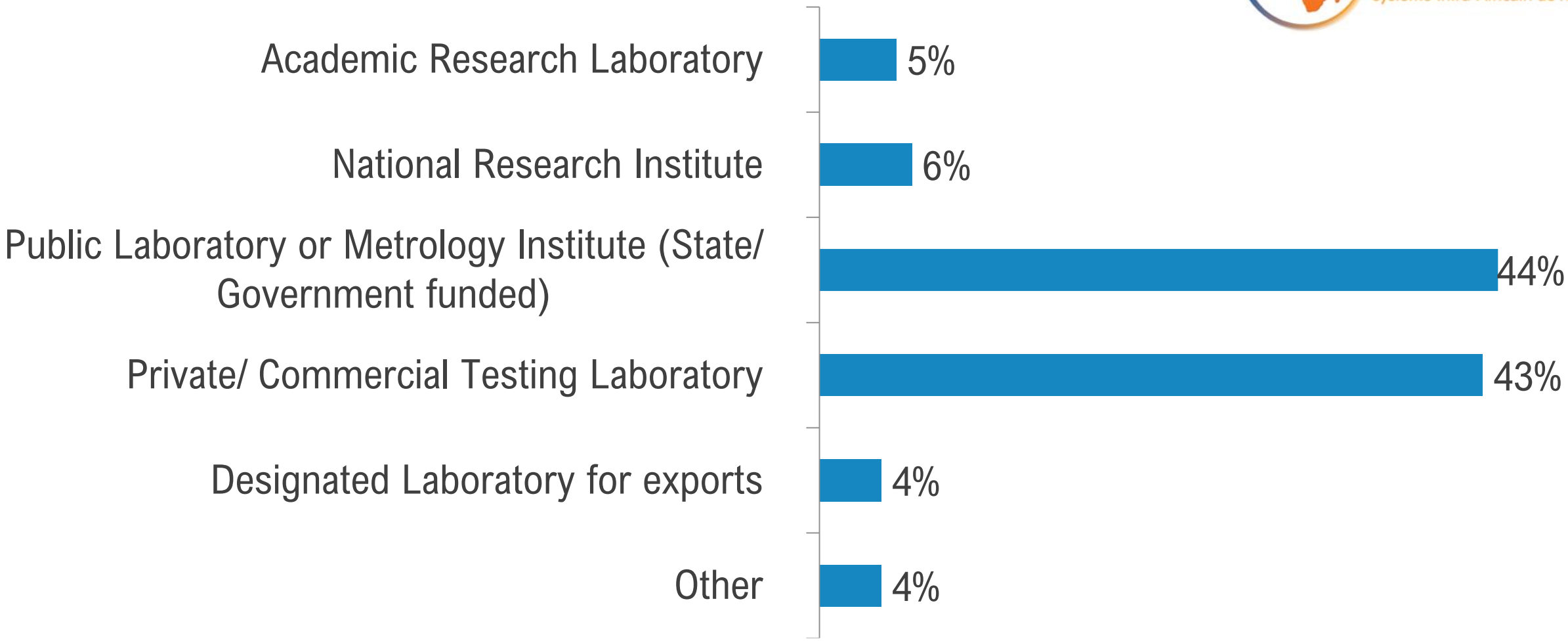
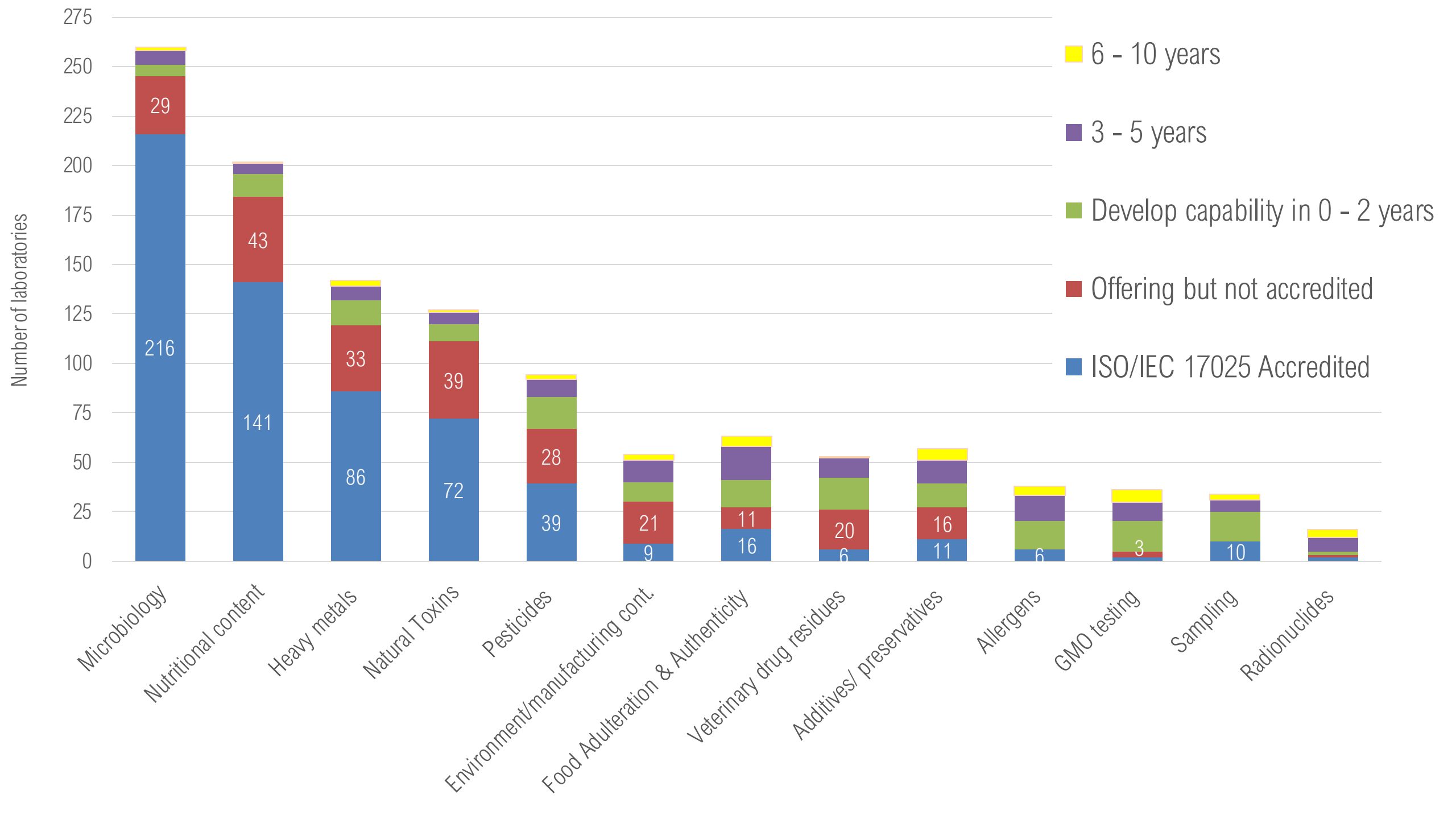


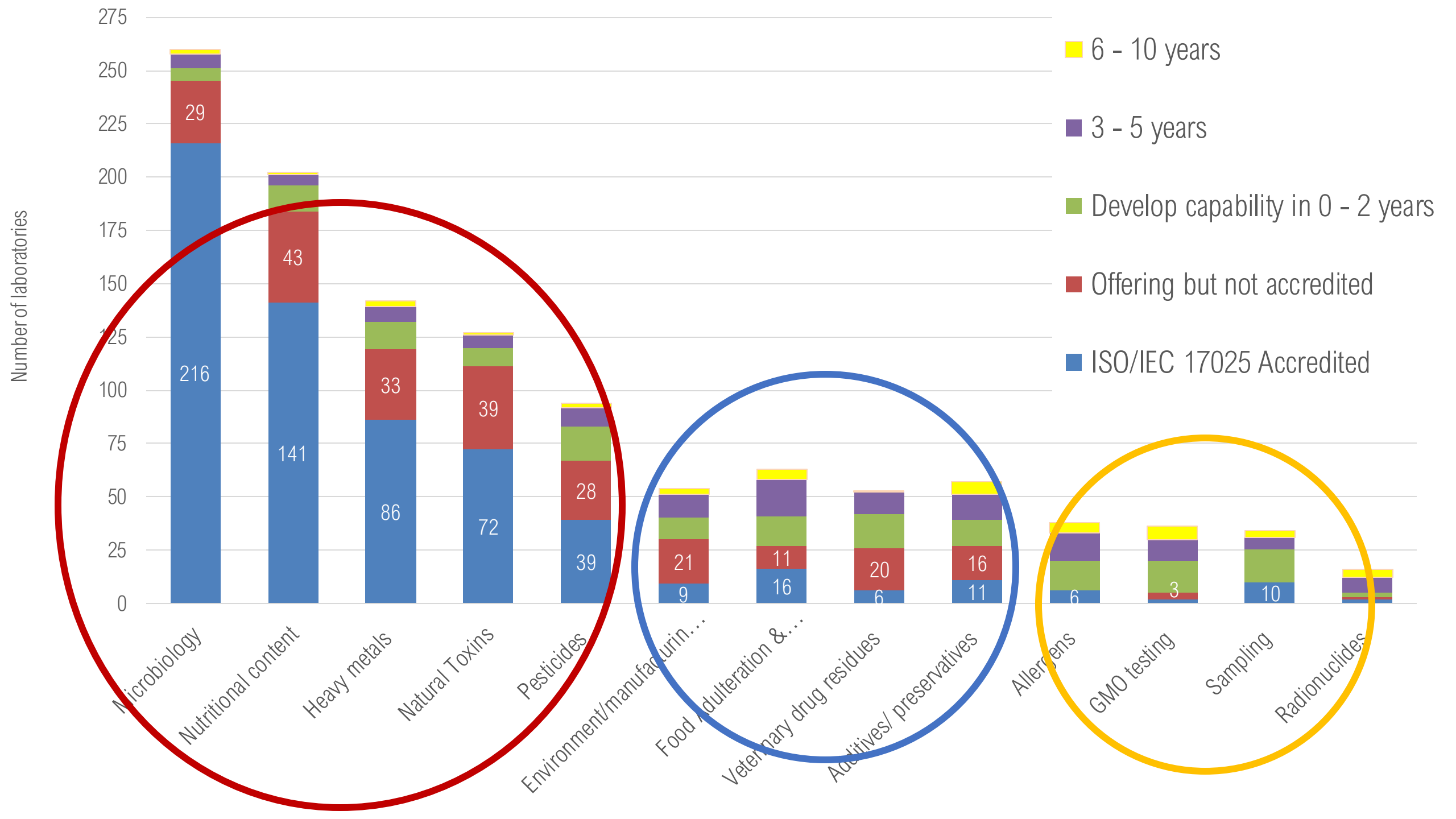
Figure 1 F: African exports to the European Union (Million Euros)

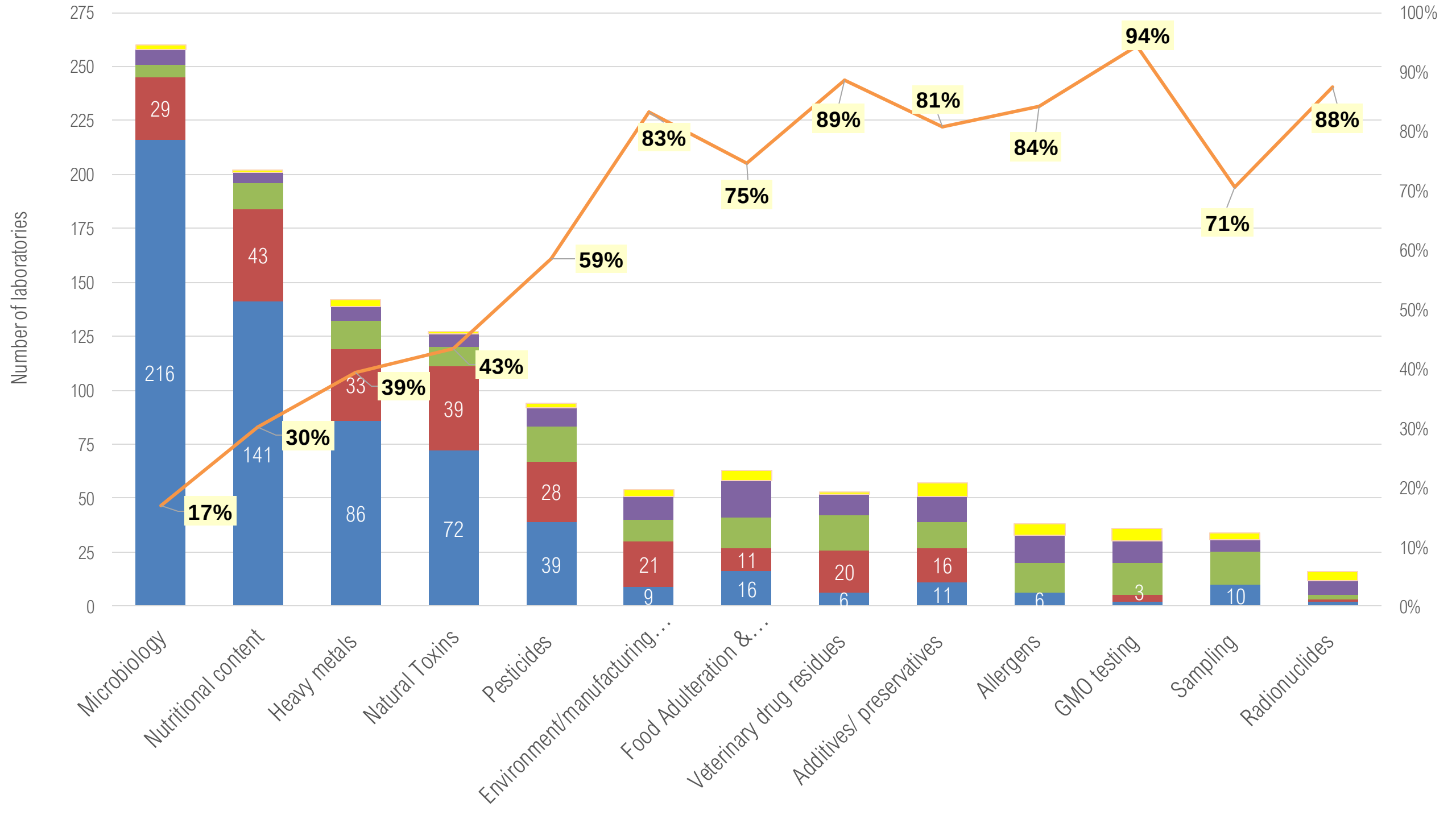




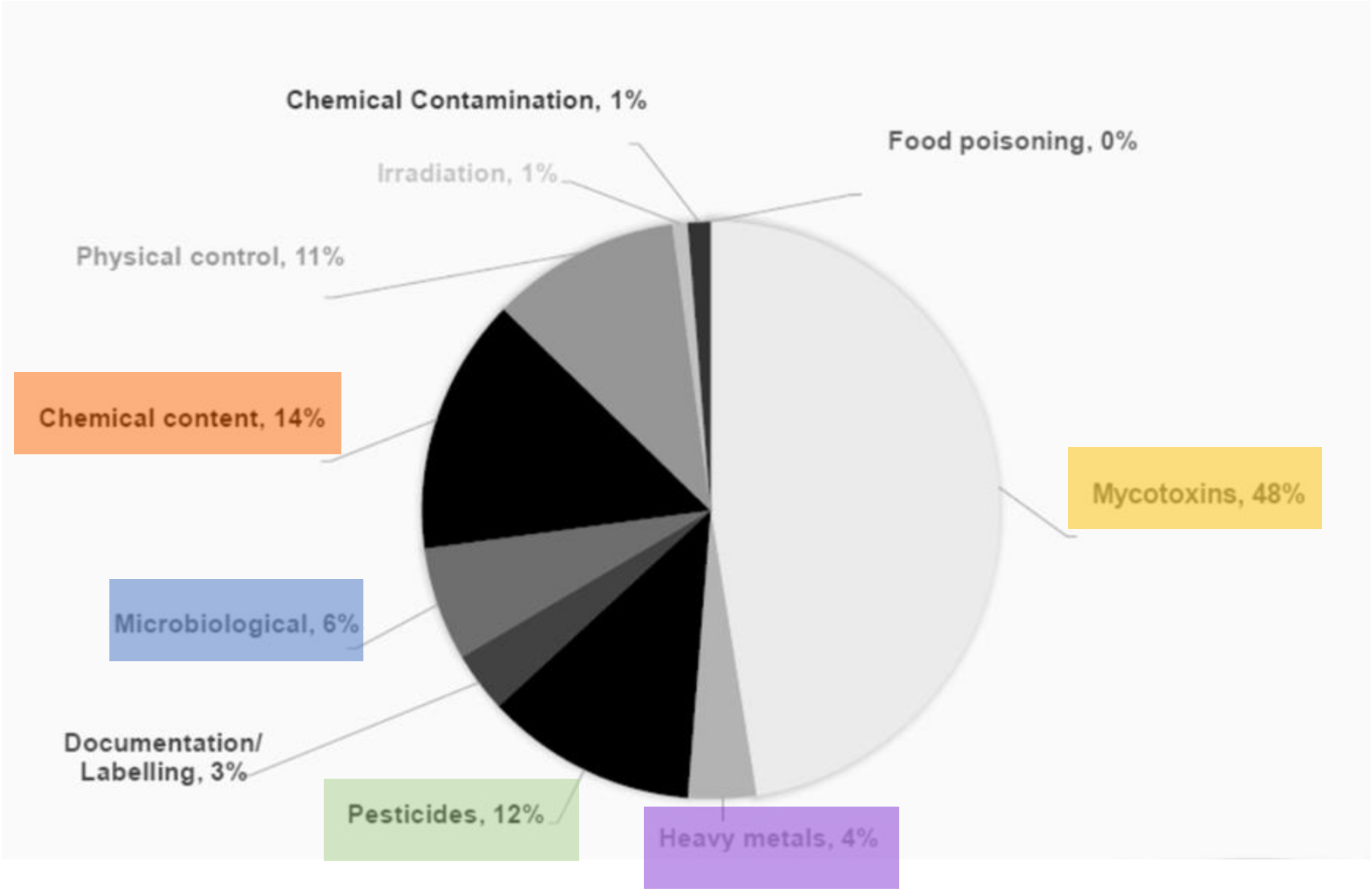
Laboratory categories of respondents including ISO/IEC 17025 accredited laboratories. Some respondents may have selected more than one category


Number of laboratories
275
250
225
200
175
150
125
100
75
50
25
0
6 - 10 years
3 - 5 years
Develop capability in 0 - 2 years
Offering but not accredited
ISO/IEC 17025 Accredited
216
29
141
43
86
33
72
39
39
28
9
21
16
11
6
20
11
16
6
3
10
Microbiology
Nutritional content
Heavy metals
Natural Toxins
Pesticides
Environment/manufacturing cont.
Food Adulteration & Authenticity
Veterinary drug residues
Additives/ preservatives
Allergens
GMO testing
Sampling
Radionuclides


Number of laboratories
275
250
225
200
175
150
125
100
75
50
25
0
6 - 10 years
3 - 5 years
Develop capability in 0 - 2 years
Offering but not accredited
ISO/IEC 17025 Accredited
29
216
43
141
33
86
39
72
28
39
21
9
11
16
20
6
16
11
6
3
10
Microbiology
Nutritional content
Heavy metals
Natural Toxins
Pesticides
Environment/manufacturin…
Food Adulteration &…
Veterinary drug residues
Additives/ preservatives
Allergens
GMO testing
Sampling
Radionuclides


Number of laboratories
275
250
225
200
175
150
125
100
75
50
25
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
216
29
141
43
86
33
72
39
39
28
9
21
16
11
6
20
11
16
6
3
10
17%
30%
39%
43%
59%
83%
75%
89%
81%
84%
94%
71%
88%
Microbiology
Nutritional content
Heavy metals
Natural Toxins
Pesticides
Environment/manufacturing…
Food Adulteration &…
Veterinary drug residues
Additives/ preservatives
Allergens
GMO testing
Sampling
Radionuclides

Notifications, alerts and border rejections received by Africa during 2019 from the European Rapid Alert System for Food and Feed (EU-RASFF)

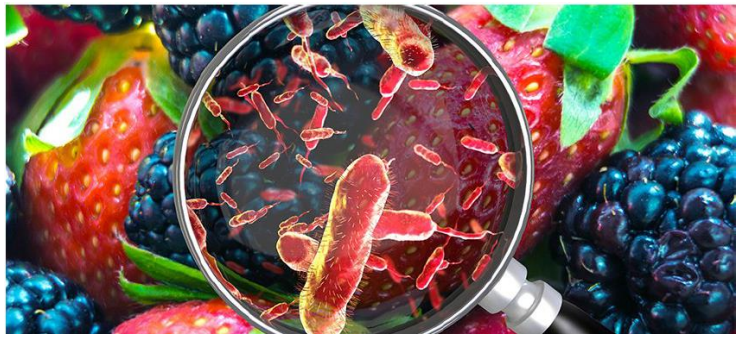


Matrices tested for each food testing category

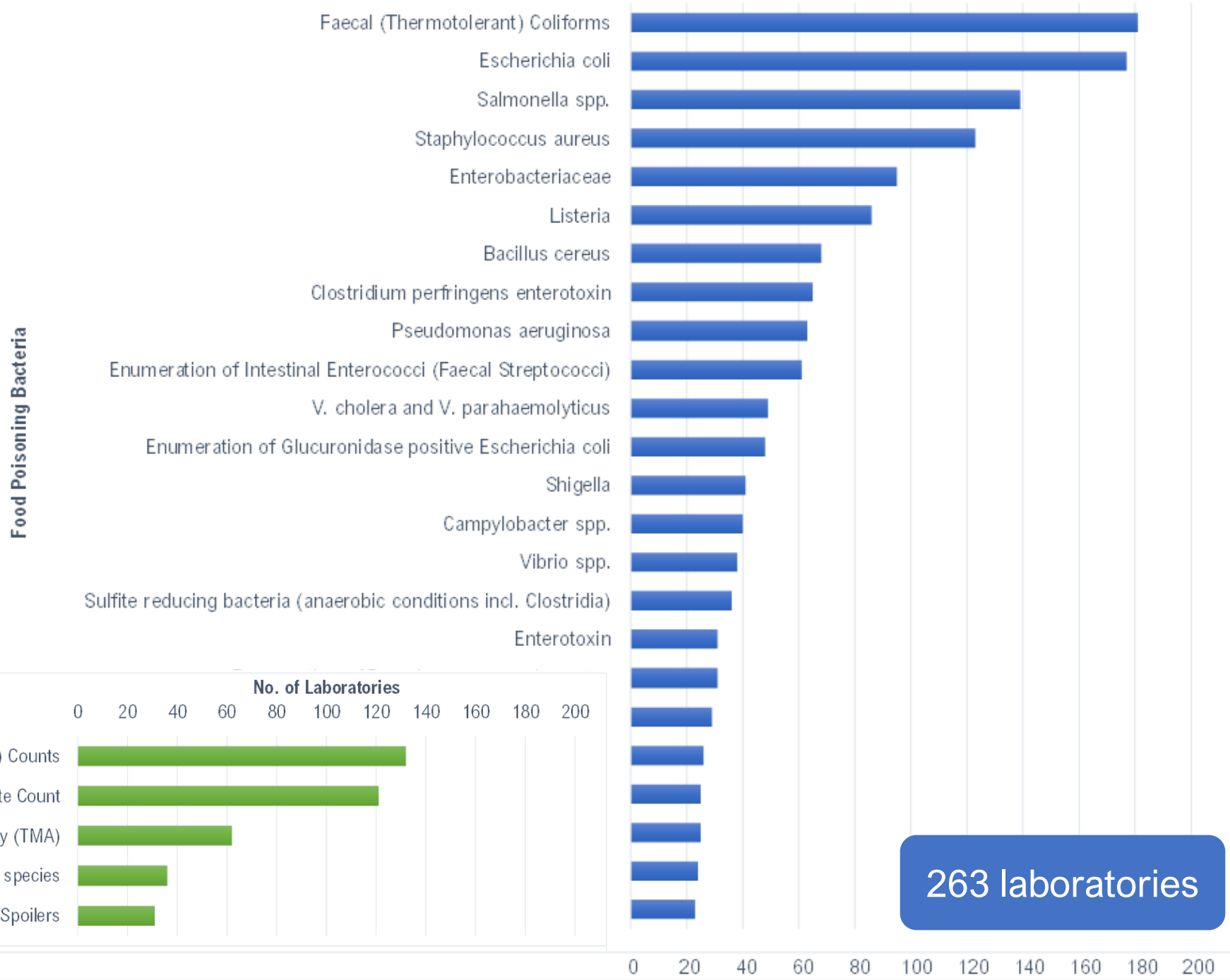
Matrix		Microbiological	Nutritional content	Toxic elements/ heavy metals	Natural toxins	Pesticide residues	Radionuclides	Additives/ preservatives	Food adulteration/authenticity	Environmental/ manufacturing	GMO testing
	%	27%	21%	19%	11%	10%	4.4%	4.2%	2.7%	0.9%	0.2%
Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)	**8.0%**	57	58	49	57	32	16	7	7	3	3
Nuts, nut products and seeds	**5.7%**	37	45	39	42	23	9	7	3	1	1
Milk and milk products (cheese, cream, yoghurt)	**5.7%**	53	43	34	31	17	7	8	9	3	0
Fruits and vegetables	**5.3%**	45	40	34	18	34	8	8	2	2	1
Water (for human consumption, mineral water)	**5.1%**	53	31	45	10	18	13	6	3	3	0
Processed fruits and vegetables	**4.9%**	45	38	33	15	24	6	9	5	2	1
Fish and Fish products	**4.5%**	44	34	33	9	16	15	6	2	3	0
Animal Feed and Pet food	**4.4%**	39	37	27	31	12	5	4	3	2	0
Meat and meat products	**4.3%**	45	35	31	10	11	7	8	6	1	0
Infant foods	**4.2%**	37	34	25	25	13	4	11	3	1	0
Fats and oils	**3.9%**	38	32	26	12	12	4	9	8	1	0
Non-alcoholic beverages	**3.9%**	43	33	23	11	5	4	11	9	1	0
Poultry meat and poultry meat products	**3.8%**	42	29	24	10	13	6	7	5	1	0
Herbs and spices	**3.8%**	37	25	25	18	18	5	5	4	0	0

Veterinary drug residues and allergens are not included.

Microbiological pathogens



- Standard ISO methods
- Of 113 responses received only 4 labs applying real time PCR

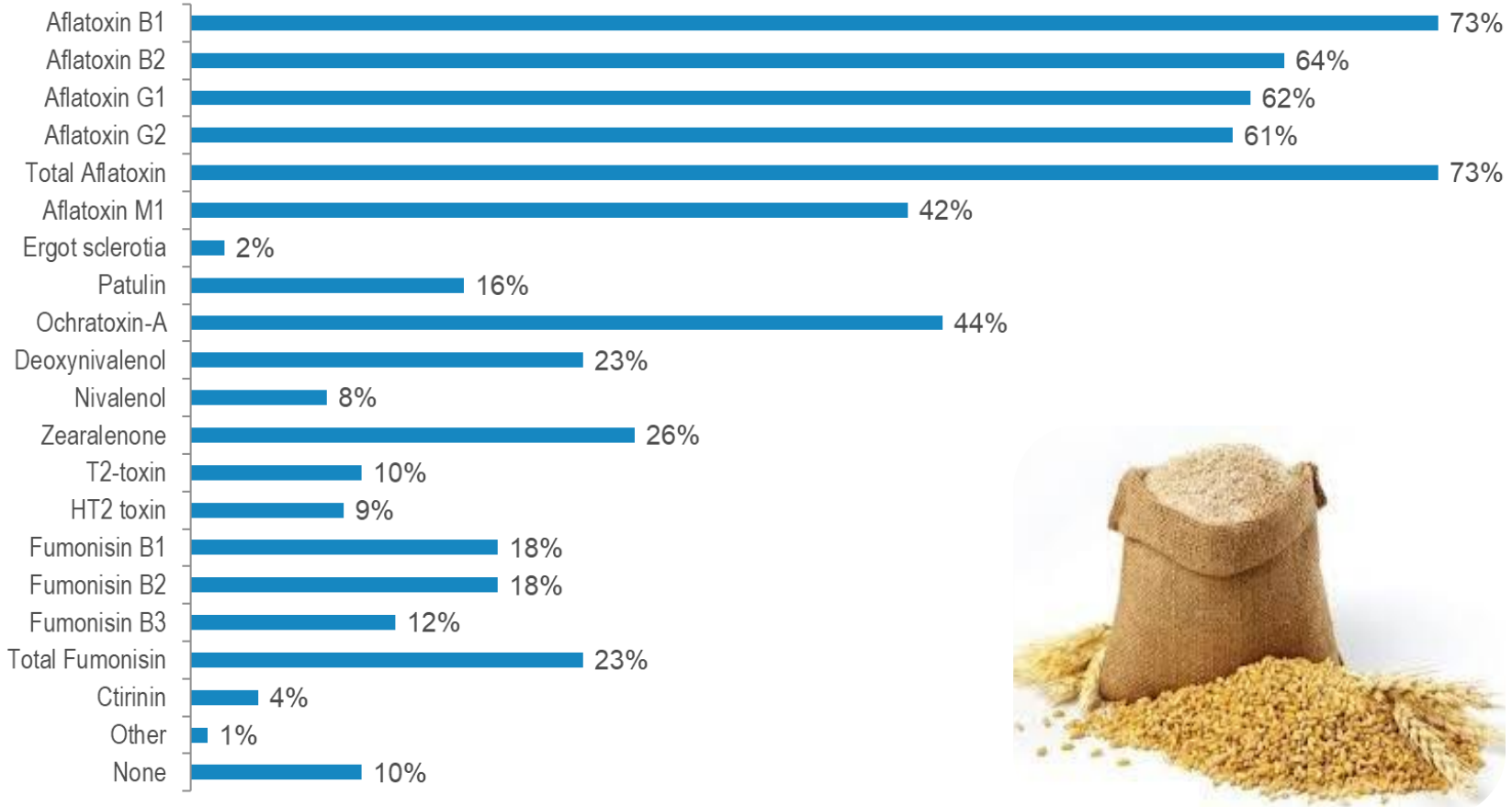


263 laboratories

Toxic and nutritional elements

121 laboratories

Natural Toxins: Mycotoxins

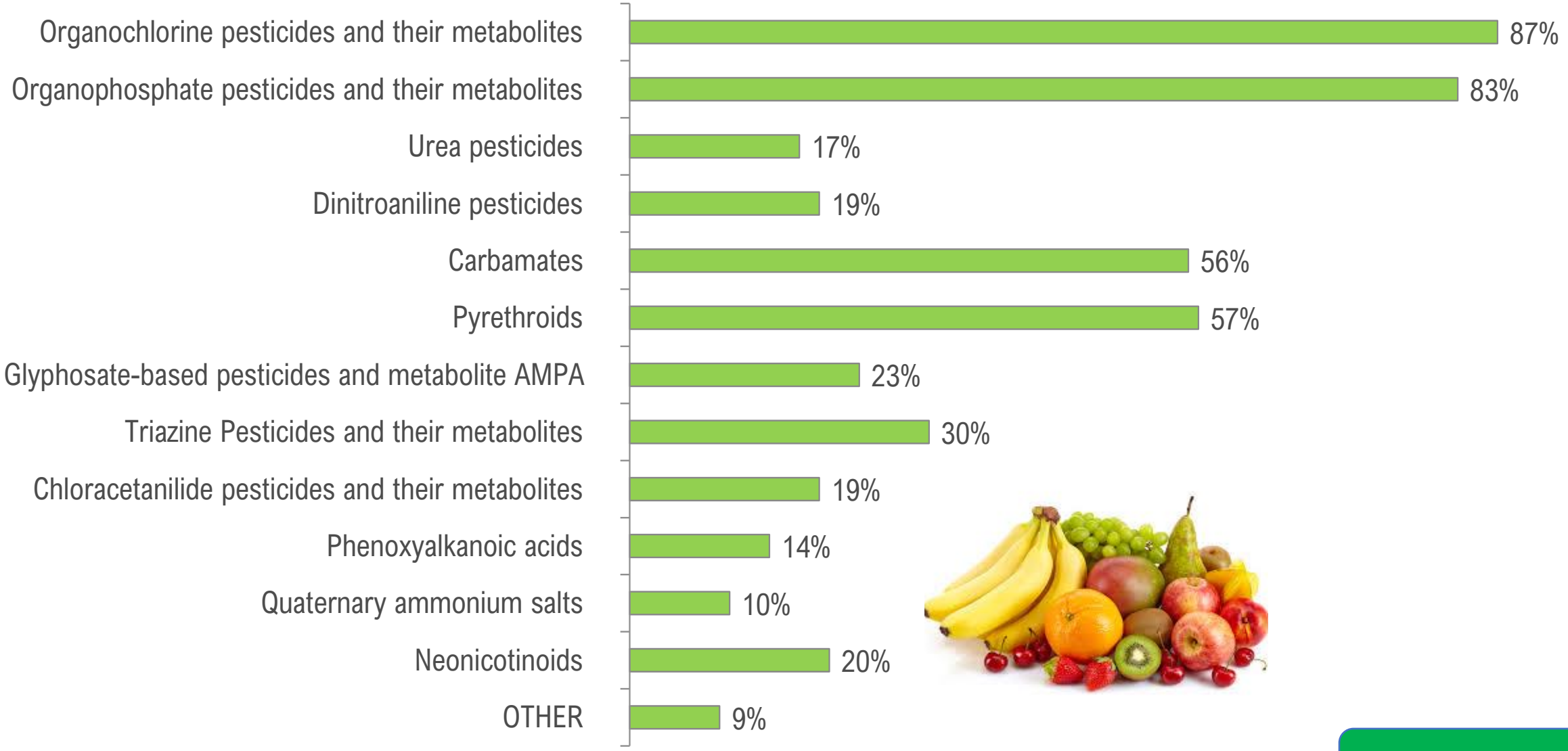


113 laboratories

Natural Toxins: Algal/ phycotoxins

34 laboratories

Pesticides



70 laboratories

Pesticides

AFRIMETS
Intra-Africa Metrology System
Système Intra-Africain de Métrologie

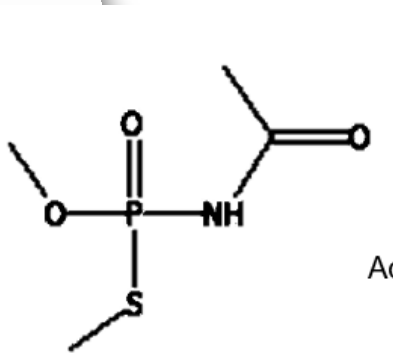
AFRIMETS.QM-S1

Mass fraction of Polar to Non-Polar Pesticides in Plum Sl

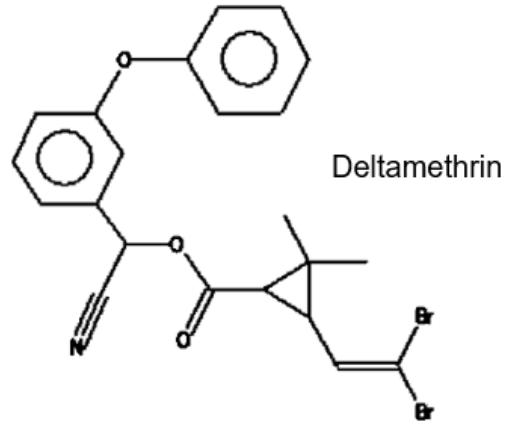
Supplementary Comparison

Study Protocol

September 2023



Acephate



Deltamethrin

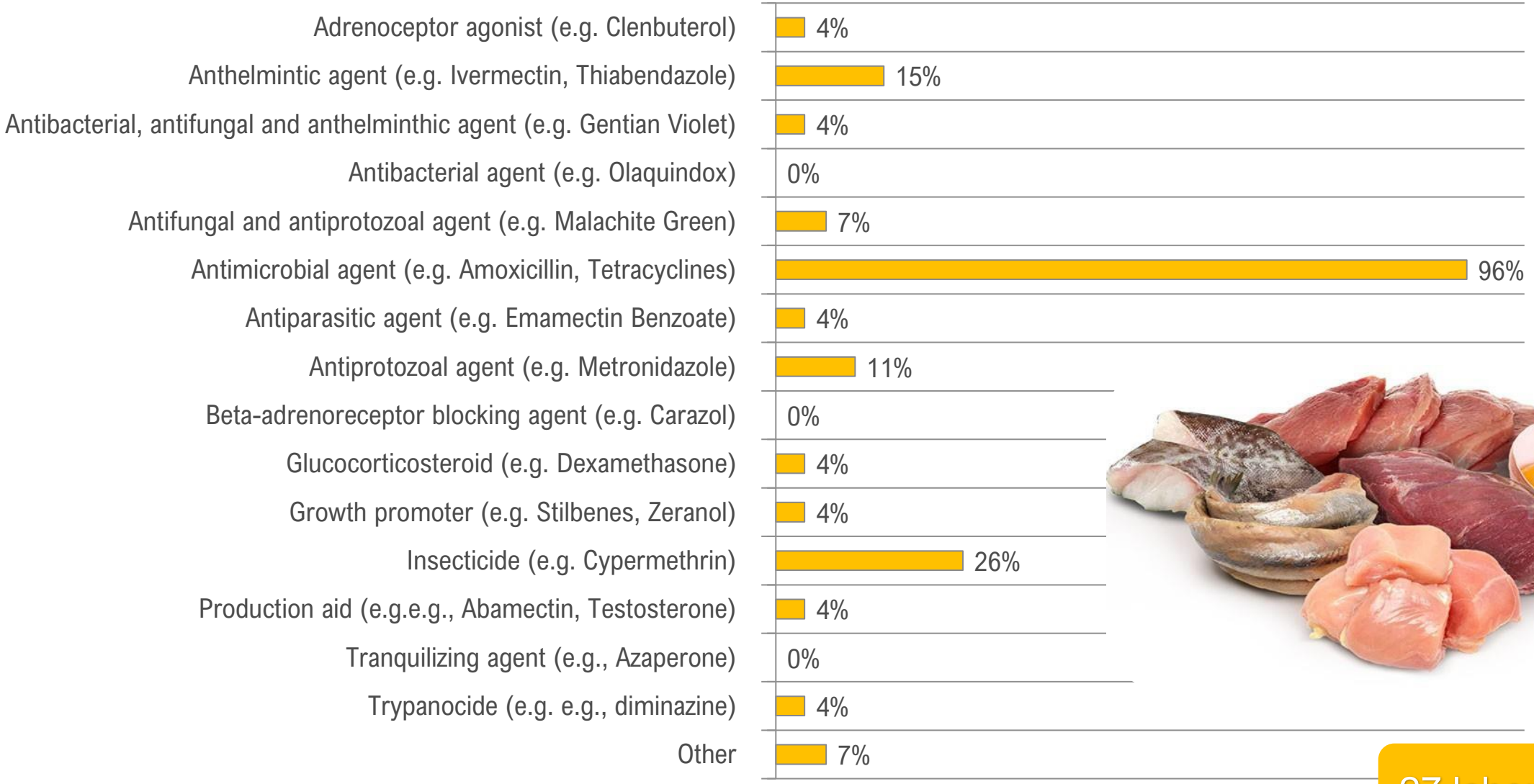
Figure 1: Structure of Acephate and Deltamethrin

Table 2: Compound information

Measurand	**Acephate**	**Deltamethrin**[#]
CAS Number	30560-19-1	52918-63-5
Substance group	Organophosphate	Pyrethroid
Molecular Formula	$C_4H_{10}NO_3PS$	$C_{22}H_{19}Br_2NO_3$
Molecular mass	183.17	505.2
***pK*$_{ow}$**	0.82	-6.2
Isomerism	Chiral molecule	Chiral molecule

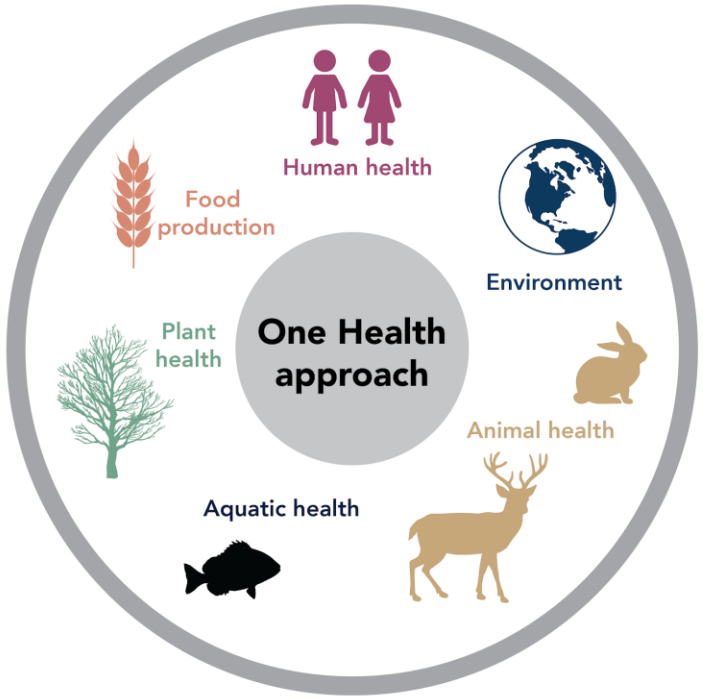
[#]Deltamethrin is the sum of *Cis*-deltamethrin its α-R- and *Trans*-isomers.

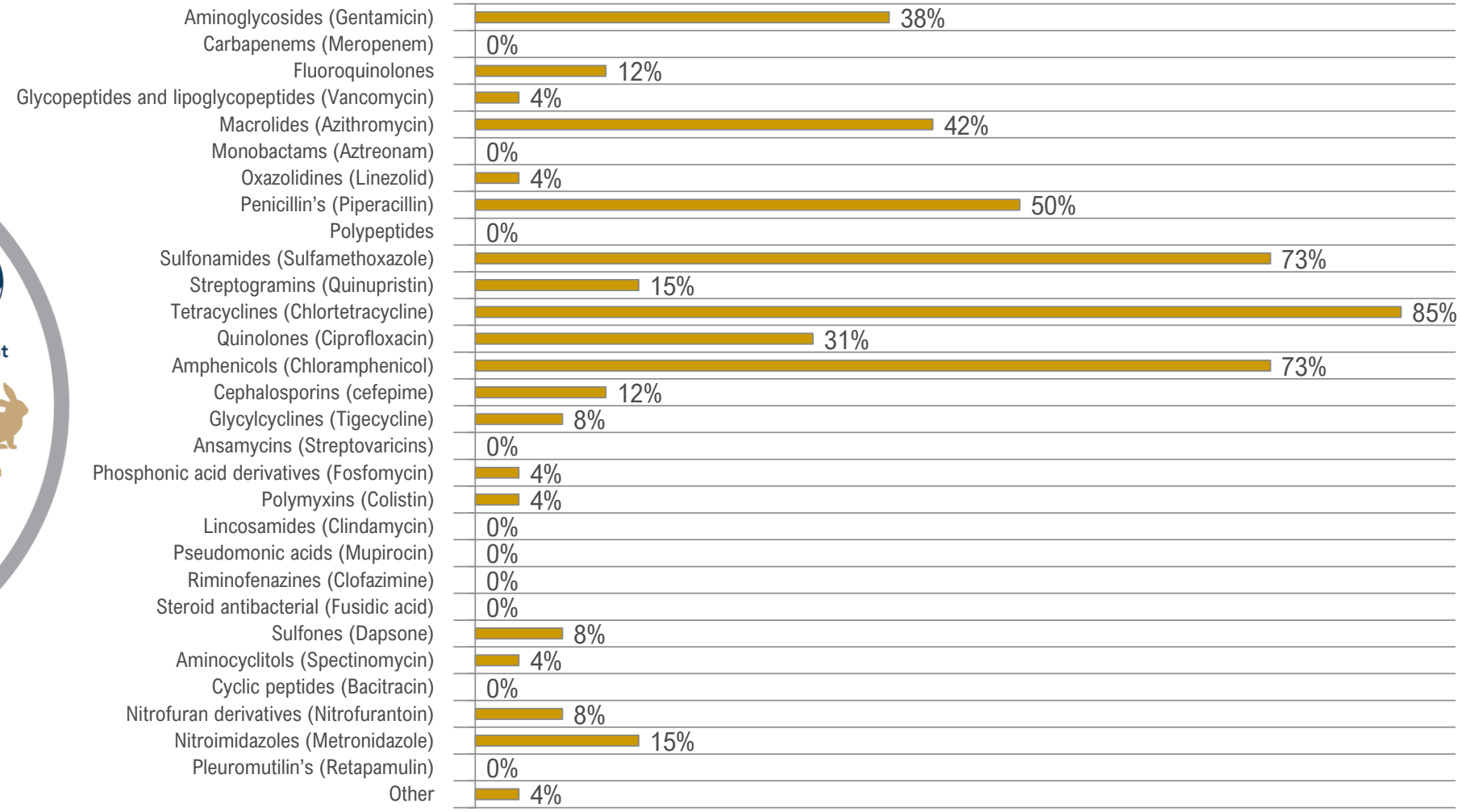
Veterinary Drug Residues



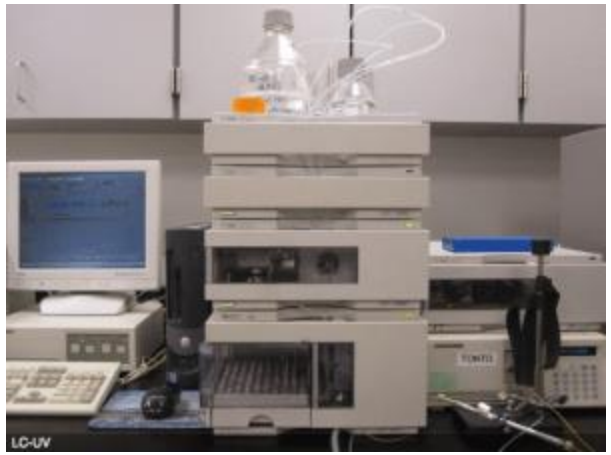
27 laboratories

Antimicrobials





Instrumentation and equipment in participant laboratories



113 laboratories

Challenges

Supply chain challenges

- Lead times for delivery of consumables
- Restricted budget and procurement procedures
- Sub-standard laboratory materials have flooded the market
- Import of CRMs and chemicals
- Availability of suppliers, local agents, maintenance and repairs most difficult,
- Difficult to renew old materials
- Calibration services

Funding

•Lack of commitment of top management in providing resources and infrastructure.

•Limited funding to replace old instrument (no longer serviced by instrument suppliers)

•Maintenance of laboratory infrastructure

•Customers do not accept analysis costs (quotes)

Instrument support services too costly

•Low customer demand

•Insufficient equipment

•Underfunding

Infrastructure & Technology

- Not enough space
- Risk Analysis Systems (RAS)
- Lack of general database for analysis.
- Automation of result interpretation
- Non access to the instruments
- Obsolete and redundancy of lab equipment
- Laboratory not well equipped

HR

•Limited HR/ staff

Staff demotivated, poor salaries

Education, shortage of skilled manpower, low skill level of analysts

Unable to meet PT result submission deadlines

•Insufficient knowledge in result interpretation.

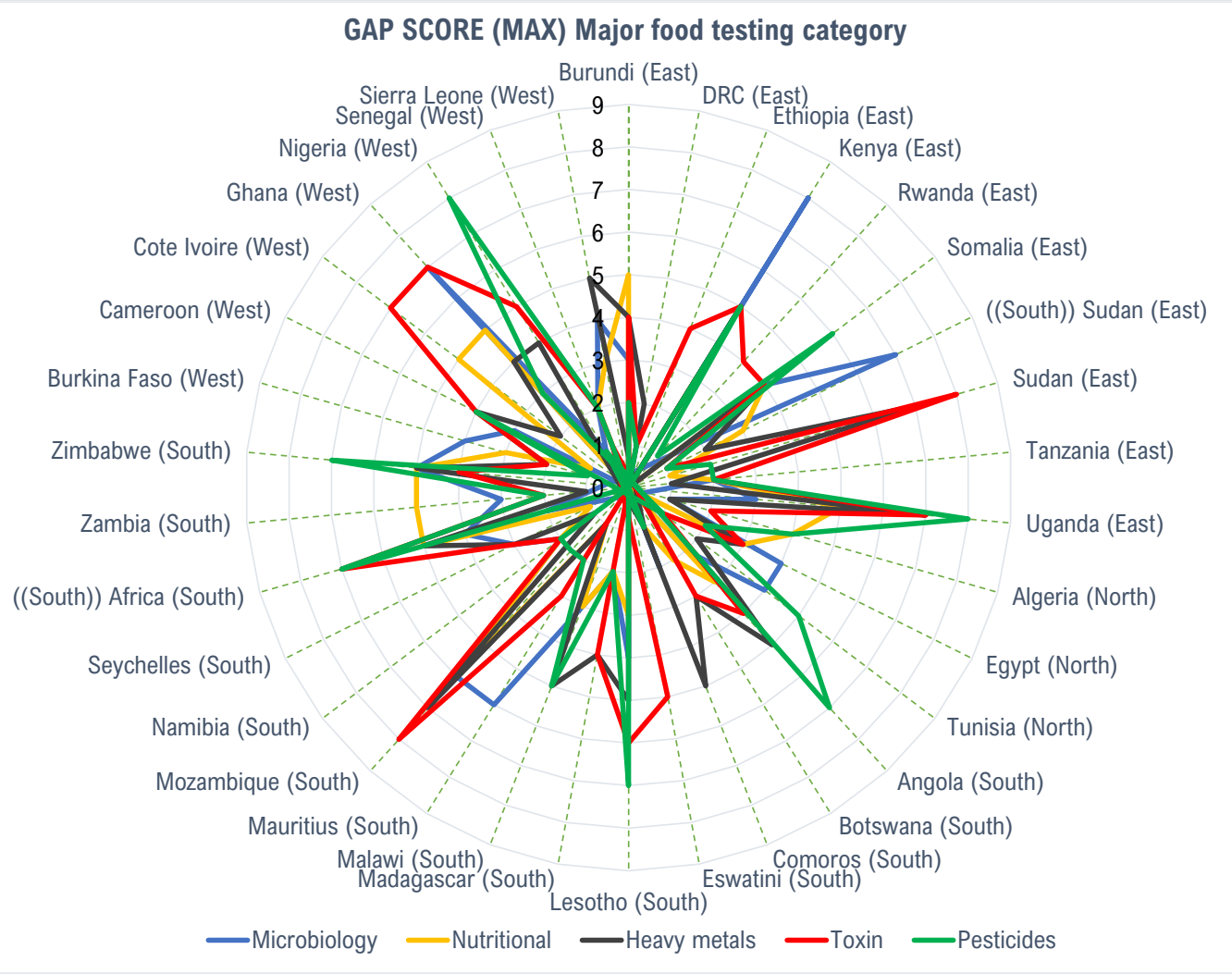
•Limitation on amount of staff employed and replacement of retiring staff members

Ranked laboratory challenges

Weighted ranked difficulties (1 being least difficult and 5 most difficult)	1	2	3	4	5
Delays caused by importing chemicals, reagents and equipment, instrument spares/ repairs	5	10	34	34	118
Lack of instrument supplier's maintenance and training support	13	22	34	52	96
Operational expenses are too high	7	14	52	34	92
OTHER	50	16	16	22	72
Technology and digitalisation limitations	9	20	58	66	64
Training and retaining of analysts	6	30	54	68	62
Lack of access to relevant PT schemes, reference materials	15	34	66	46	50

1 = least challenging; 5 = most challenging

Key recommendations



1. Prioritize National Needs: prioritize gaps identified according to country GAP scores.

COUNTRY NEED:
1 is not important
10 is very important

IMPLEMENTATION:
1 indicates not yet implemented
10 indicates fully implemented

GAP SCORE = COUNTRY NEED (IMPORTANCE) – LABORATORY IMPLEMENTATION

Key recommendations

AFRIMETS
Intra-Africa Metrology System
Système Intra-Africain de Métrologie

1. **Prioritize National Needs**: prioritize gaps identified according to country GAP scores.

2. **Instrument Training**: for routine operation, maintenance, and troubleshooting.

3. **Training Support**: For monitoring + inspection labs to obtain ISO/IEC 17025 accreditation, implement QMS, and address technical elements within the standard, such as method validation, metrological traceability and the use of standard methods of analysis (ISO, AOAC, etc).

Key recommendations

Testing of Staple Commodities: Focus on testing cereals and regionally boosted cereal commodities for mycotoxins, heavy metal contamination, pesticides, and mandatory fortification of vitamins and macro/micronutrients.

Microbiological Testing: Address the challenges in microbiological testing and support labs in becoming accredited in this category within the AfCFTA.

Molecular Biology Platforms: Provide support for labs interested in implementing molecular biology platforms for microbiological testing (strain identification).

Key recommendations

Testing of Fruits and Vegetables: Conduct testing of pesticides in regionally relevant fruits and vegetables for intra-regional trade, including those at risk of trade bans.

Testing of Animal and Animal Products: Support the supply of reference materials and proficiency testing schemes for sectors such as fish, poultry, and meat. Address issues related to importing and clearing animal products.

Veterinary Drug Residues: Address concerns about antimicrobial resistance (AMR) and uncontrolled drug use in the animal and fish production industry.

Key recommendations

Fats and Oils Testing: Enhance testing for fats and oils, including associated parameters for edible oils, where limited quality control materials are available.

Centralized Training Hub: Consider establishing a centralized AfCFTA training hub and reference laboratory for food fraud and adulteration testing, as well as reference methods for emerging contaminants, such as microplastics.

2023-2024 Training courses

AFRIMETS
Intra-Africa Metrology System
Système Intra-Africain de Métrologie

Instrument Maintenance Operation Troubleshooting*

- GC & GC-MS
- LC & LC-MS
- ICP-OES & MS

ON-SITE*

Summer schools

- Mycotoxin
- Pesticides
- Toxic elements
- Nutritional

- Develop & validate methods. Report

Interactive on-line sessions with practical

- Chemical metrology
- Traceability, UoM, method validation
- Practical sample analysis & assessment
- Workshop

Proficiency Testing Schemes

- Mycotoxins
- Pesticides
- Toxic elements
- Vet drugs

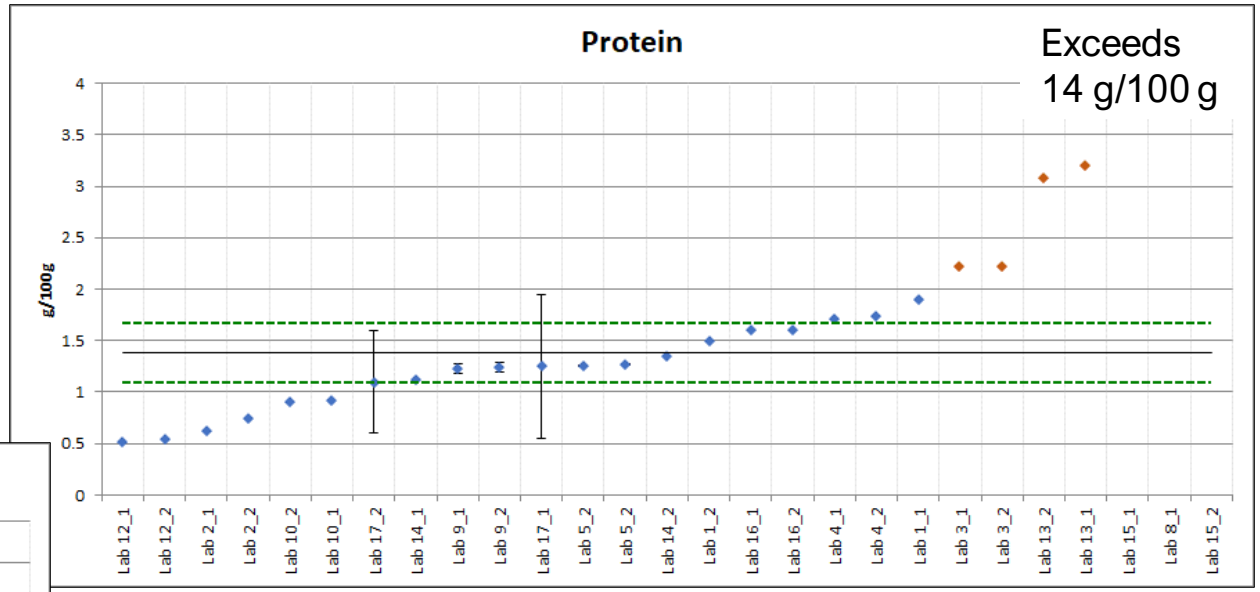
- Continued competence

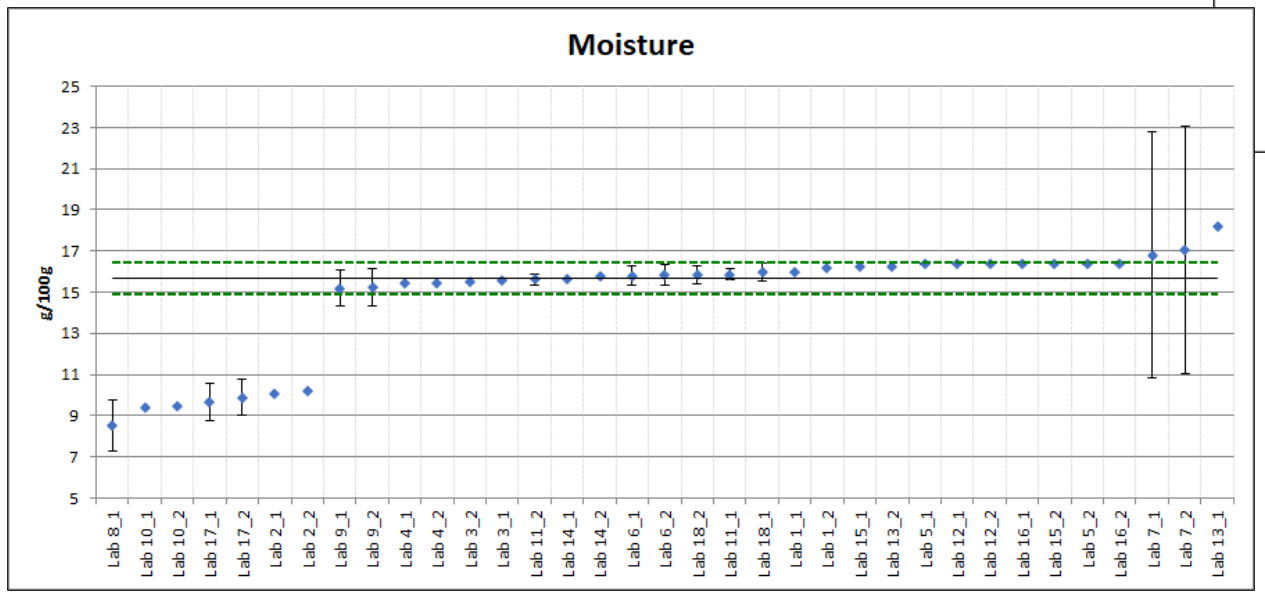
Cassava Project

- Staple food for both humans and domesticated animals throughout Africa.
- Although 54 to 61% of all cassava is produced in only four countries, it is traded across many African countries.
- Ideal case study for the African Quality Infrastructure, specifically looking at laboratory readiness in assessing basic food safety parameters:
- Toxic metals; pesticides; mycotoxins; and for cassava specifically, hydrogen cyanide (HCN).
- These food safety parameters are required to comply with CODEX Africa and REC standards, for intra-Africa trade but also for exports outside the African region.
- 20 Laboratories participating in custom NMISA Cassava PTs, followed by workshops

Cassava Project

Broadly, better agreement in the results reported for moisture may be attributed to the relative simplicity of the measurement as well as the prescribed method for moisture (although not used by all laboratories





The low protein content in cassava presents a more challenging measurement and may have contributed to the increased spread for this parameter.

Cassava Project

	Assigned Value mg/kg	δp	%RSD PT	%RSD participants	total no. z-scores	% z-scores |z|<2		Assigned Value mg/kg	δp	%RSD PT	%RSD participants	total no. z-scores	% z-scores |z|<2
Cadmium (Cd)	0.0157	0.0034	22	271	16	25	Nickel (Ni)	0.058	0.013	22	120	13	0
Calcium (Ca)	222	16	7.1	161	21	19	Phosphorus (P)	1177	65	5.5	63	13	38
Chromium (Cr)	0.0307	0.0068	22	187	15	0	Potassium (K)	1636	86	5.3	45	15	20
Copper (Cu)	1.29	0.20	15	103	18	39	Sodium (Na)	7.63	0.90	12	149	17	12
Iron (Fe)	10.5	1.2	11	136	26	31	Sulphur (S)	1243	68	5.5	75	6	67
Lead (Pb)	0.00207	0.00045	22	161	13	7.7	Zinc (Zn)	7.90	0.93	12	73	24	54
Manganese (Mn)	6.69	0.80	12	43	14	43	% Moisture	13.72	1.48	11	21	21	52

PTs currently underway for:
Pesticides, mycotoxins and HCN in cassava, ending March 2024
Second rounds requested for improvement

AFRIMETS
Intra-Africa Metrology System
Système Intra-Africain de Métrologie

NMI/DI representatives from Egypt, Kenya, Tunisia, Uganda, Eswatini, Rwanda, Tanzania, Zambia, and Zimbabwe

NMISA Team

Support:

- AFRIMETS Secretariat
- PTB – German Cooperation
- IAEA-FAO Africa Food Safety Network
- AOAC Africa
- SA NLA, US-FAS
- PAQI

Thank you