



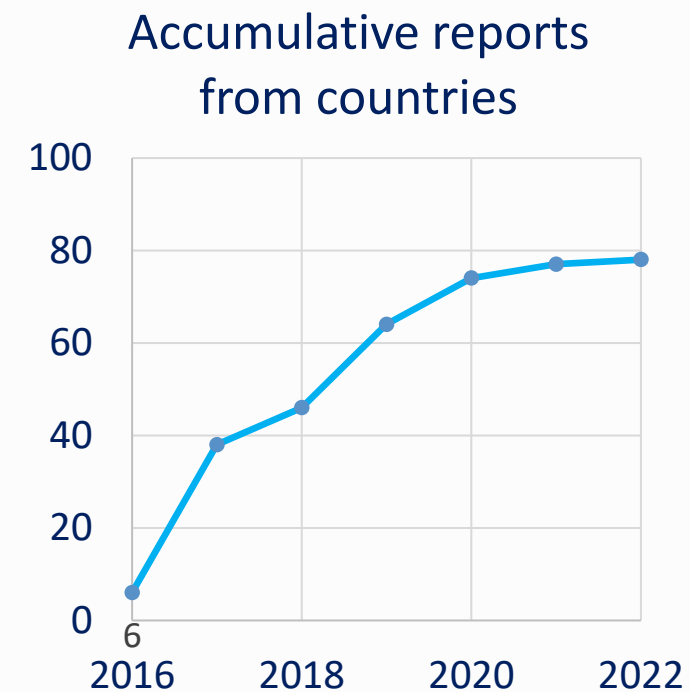
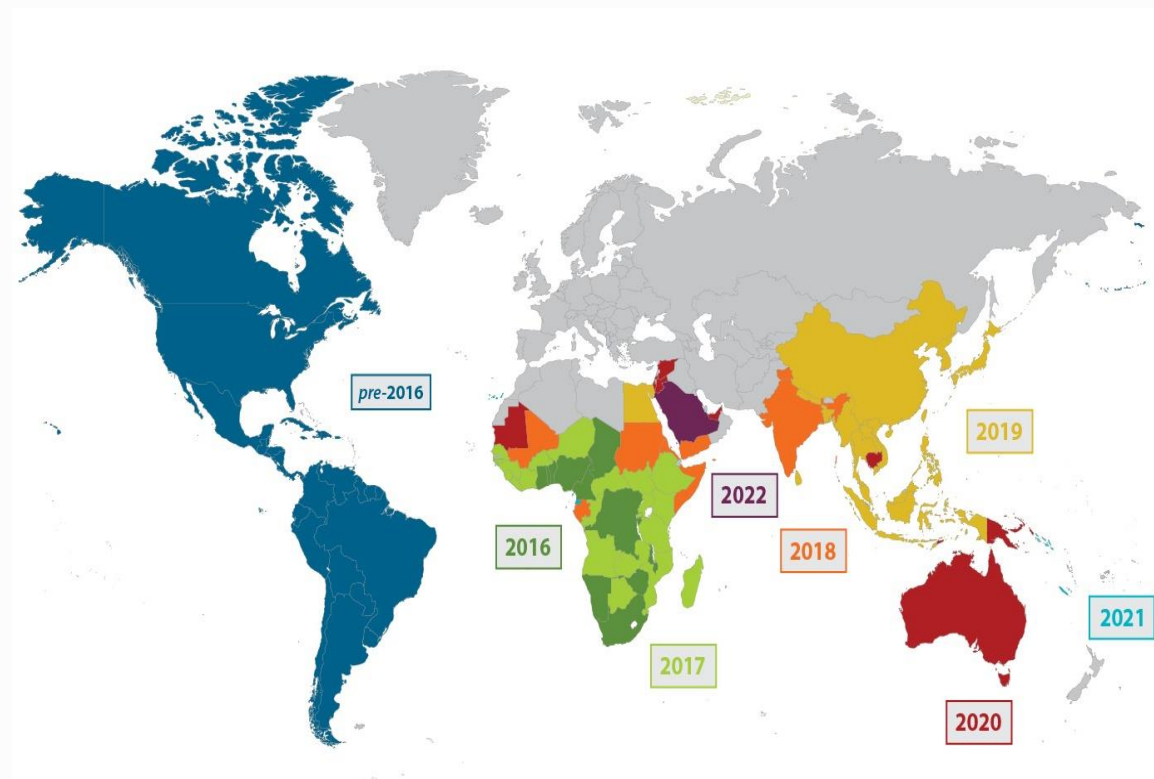
Food and Agriculture Organization
of the United Nations

Global Action for Fall Armyworm Control and Biological Control

Buyung Hadi

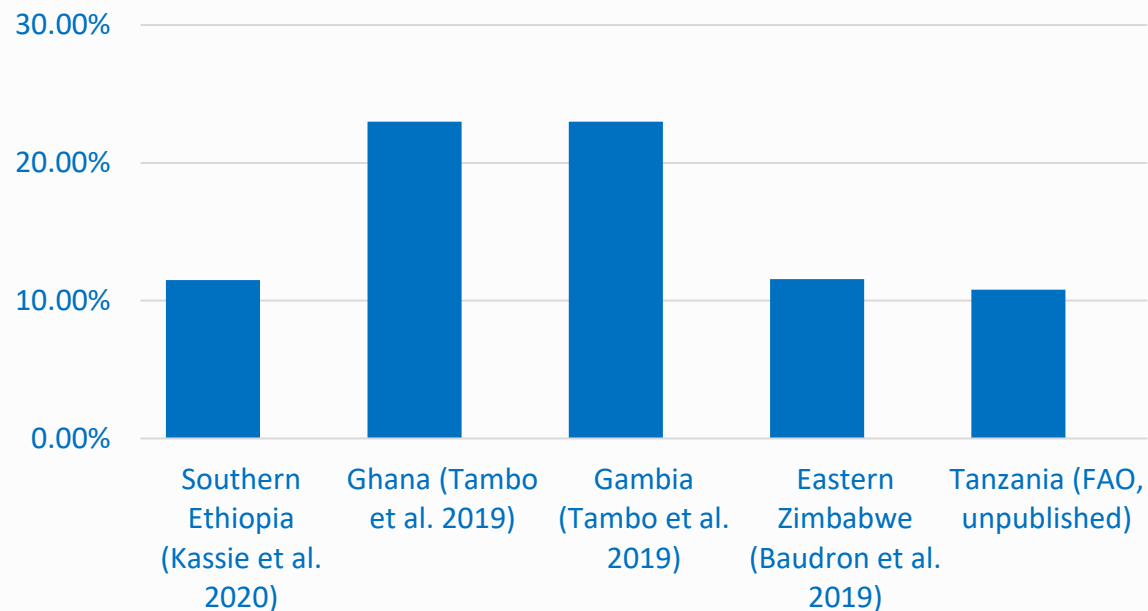
FAO Plant Production and Protection Division (NSP)

Fall armyworm invasion (2016-2022)

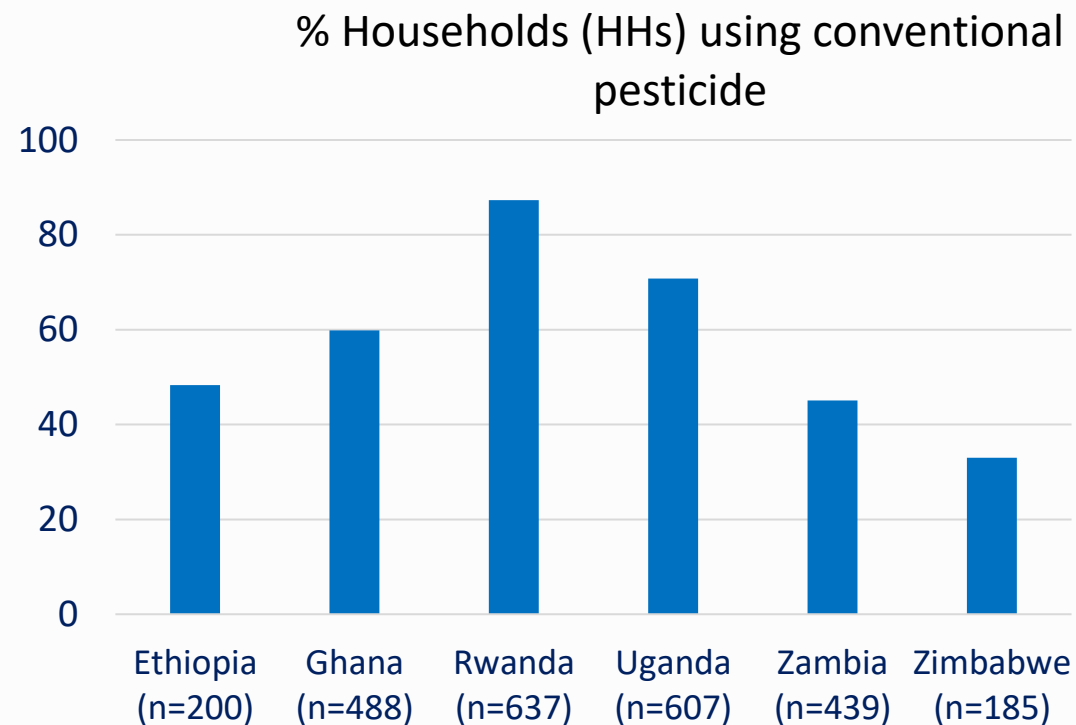




Challenges: yield loss and pesticide



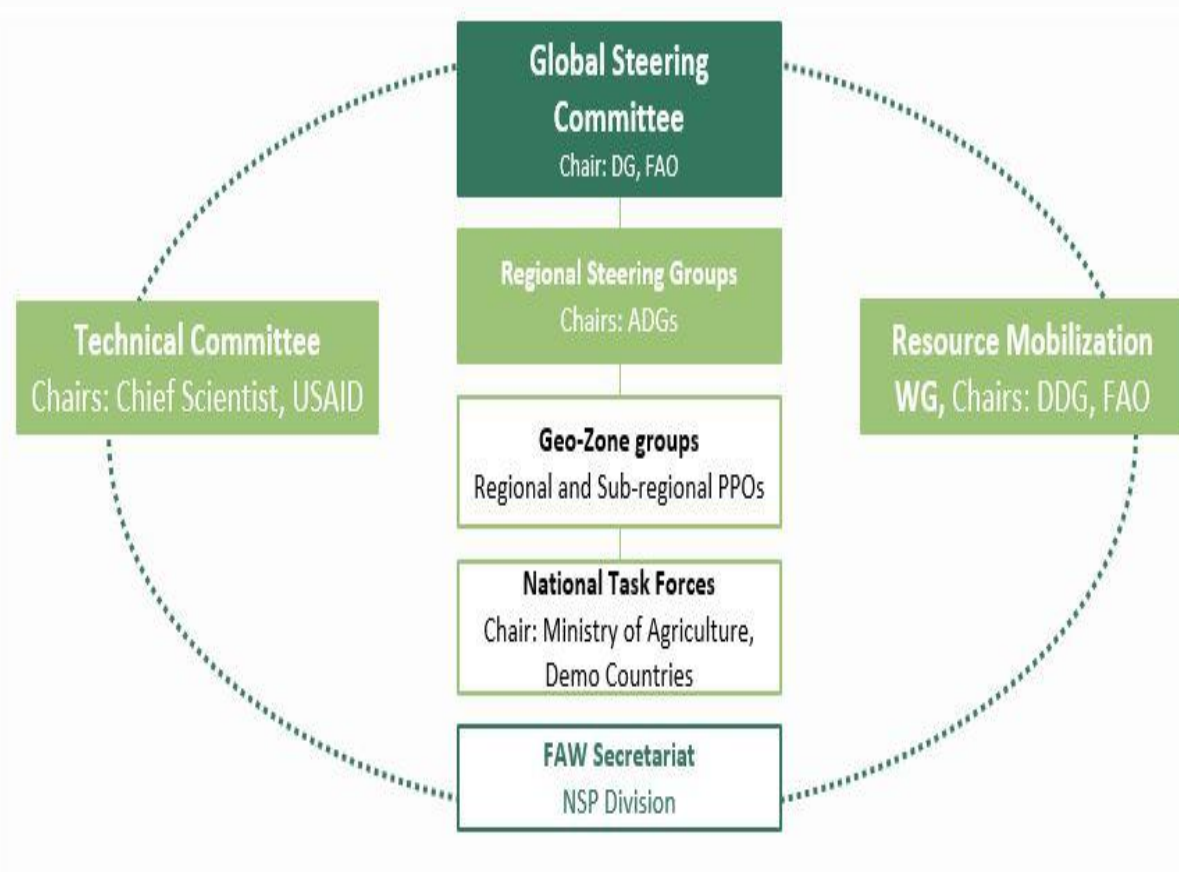
Yield loss is worth USD 9.4 billion per year in Africa, the highest among all invasive alien species in the continent (*Eschen et al. 2021*)



Kumela et al. 2018; Tambo et al. 2020

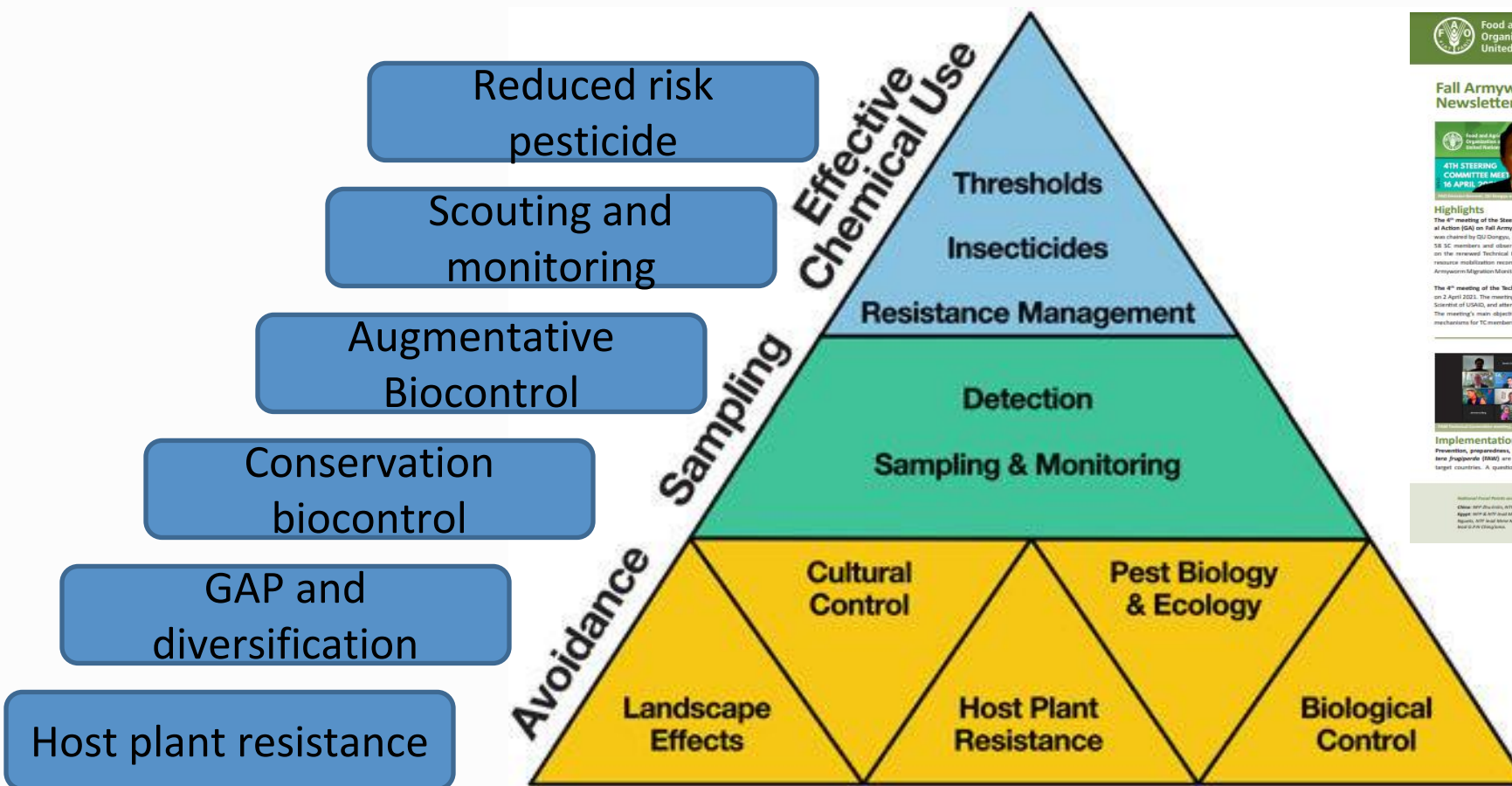


FAO GA-FAW (2019-22)





GA for FAW Control: Strategy



<https://www.fao.org/fall-armyworm/resources/en/>

IPM Pyramid (Naranjo 2011)



Global Mapping of Plant Health Research: Where is Biocontrol?

- Characterization of global / regional pest management science
- Systematic literature review covering 2010-2020 (Web of Science)
- Focus 'pest' and 'pest management' – 3 400 papers screened
- 65 countries in the global south, including LAC (apart from Brazil), Western Africa, NENA, Southeast Asia
- Thematic and institutional mapping
- Zoom-in on FAW mitigation invaded range (Africa, Asia) during 2020-2022
- Screening of Web of Science literature database
- Three analytical lenses
- Structure/composition of IPM pyramid (as per Naranjo et al., 2019)
- Biodiversity to agro-ecological outcomes 'Spiral approach' (as per Gonzalez-Chang et al., 2020)

communications earth & environment

ARTICLE



<https://doi.org/10.1038/s43247-023-00894-3>

OPEN

Pest management science often disregards farming system complexities

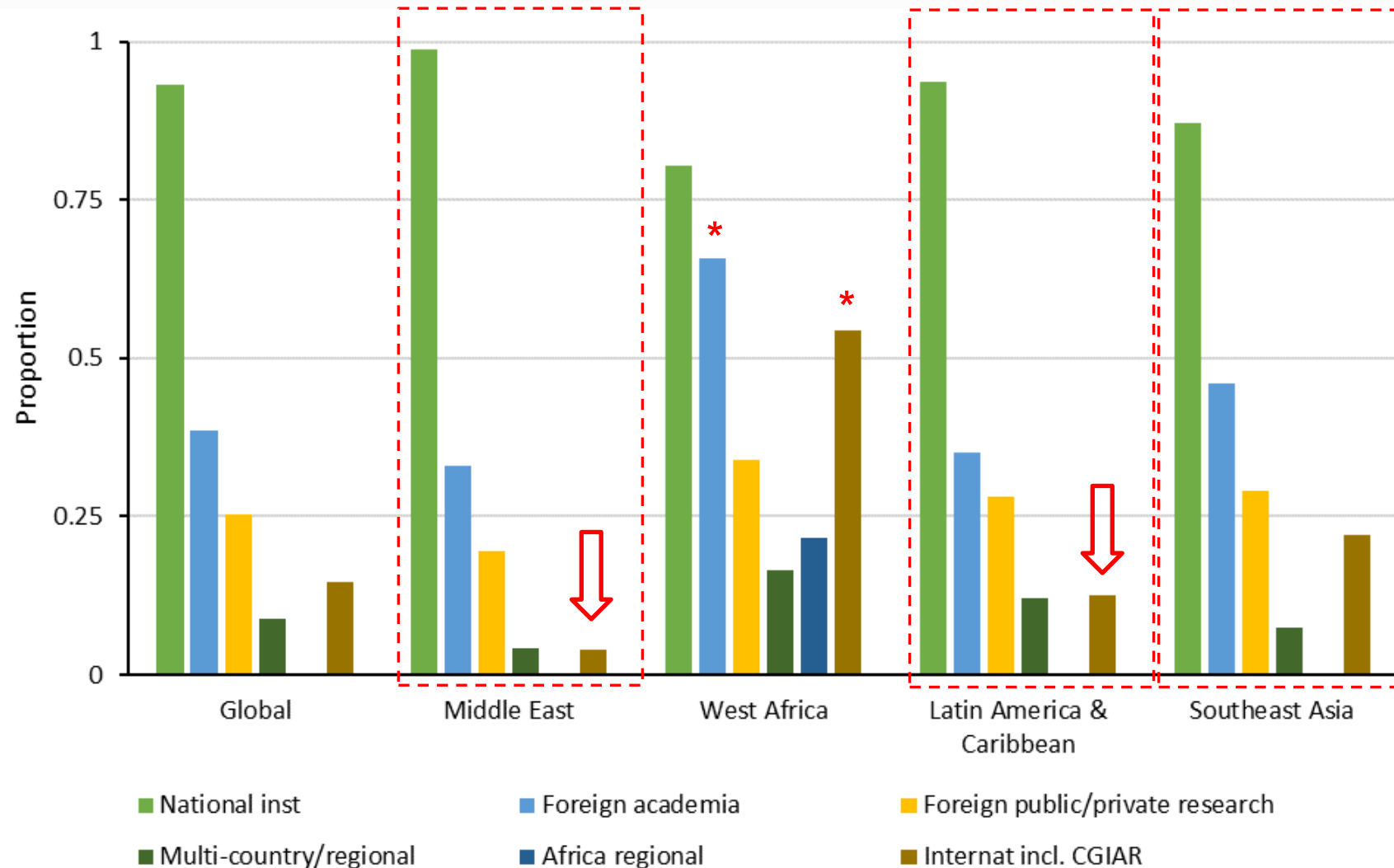
Kris A. G. Wyckhuys^{1,2,3}, Fiona H. M. Tang^{4,5} & Buyung A. R. Hadi⁶

Since the 1940s, pesticide-intensive crop protection has sustained food security but also caused pervasive impacts on biodiversity, environmental integrity and human health. Here, we employ a systematic literature review to structurally analyze pest management science in 65 developing countries. Within a corpus of 3,407 publications, we find that taxonomic coverage is skewed towards a subset of 48 herbivores. Simplified contexts are commonplace: 48% of studies are performed within laboratory confines. 80% treat management tactics in an isolated rather than integrated fashion. 83% consider no more than two out of 15 farming system variables. Limited attention is devoted to pest-pathogen or pest-pollinator interplay, trophic interactions across ecosystem compartments or natural pest regulation. By overlooking social strata, the sizable scientific progress on agroecological management translates into slow farm-level uptake. We argue that the scientific enterprise should integrate system complexity to chart sustainable trajectories for global agriculture and achieve transformative change on the ground.

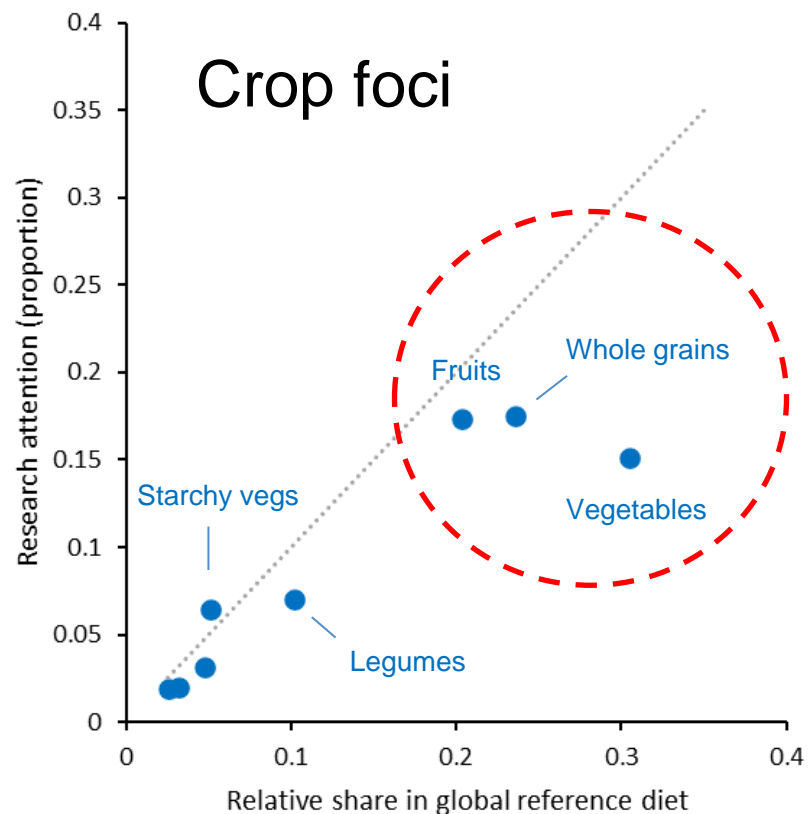


Global Mapping of Plant Health Research: Who is driving the research?

National institutions in the driver seat
30-45% backstopping from foreign academia

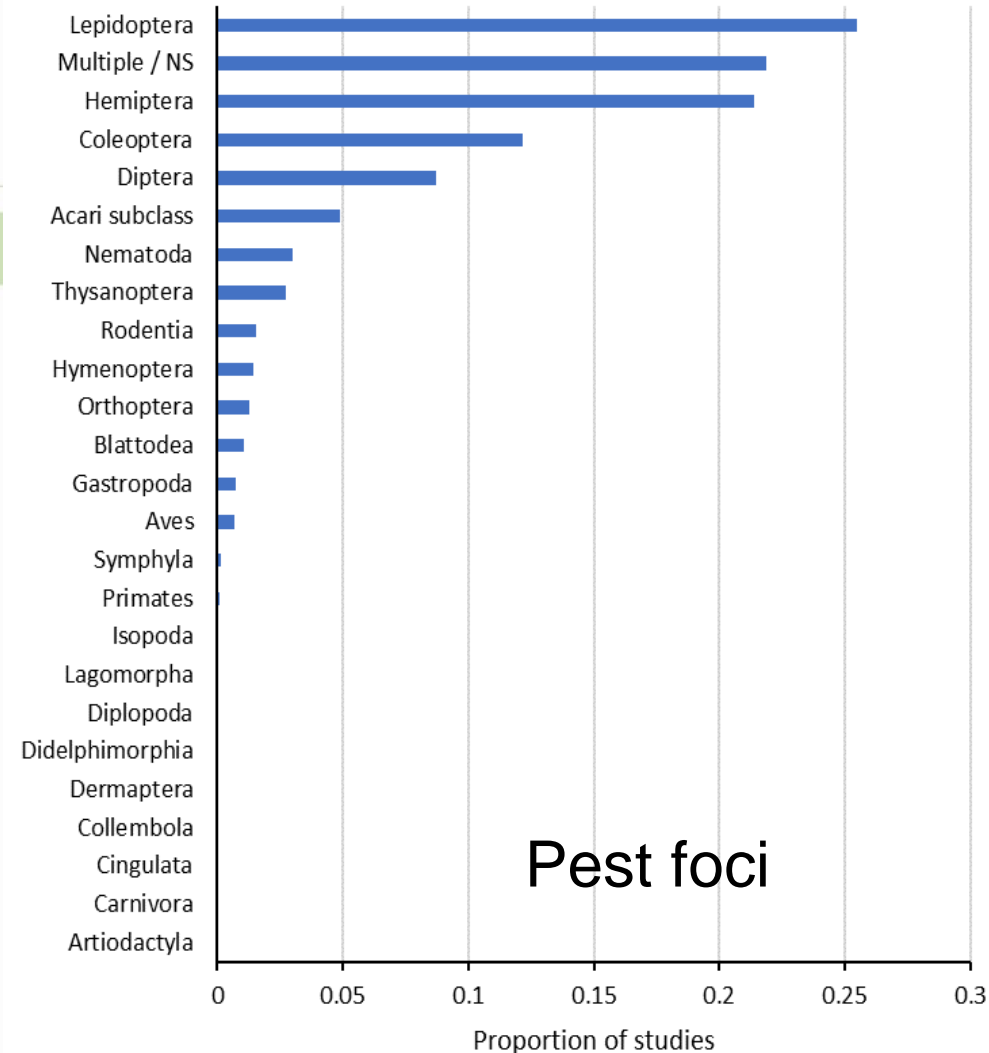


Global mapping of plant health initiatives: What are the research about?



Proportional degree of research attention to food crops, plotted against their relative share within a global reference diet – target intake of 2,500 kcal/day (EAT-Lancet 2019)

Class or order-level
research attention



- Focal pests include (recent) lepidopteran invaders e.g., *Tuta absoluta*, *Spodoptera frugiperda*, *Plutella xylostella* or cosmopolitan, polyphagous taxa e.g., *Bemisia tabaci*, *Tetranychus urticae*
- Less attention given to nematodes and vertebrate pests (rodents, birds)



Global Mapping of Plant Health Research: What are the main research topics?

All studies, worldwide (N= 3,407)

49% studies comprise field work, 48% laboratory or desktop, 8% review, 6% greenhouse or semi-field

Primary focus on pest biology & ecology

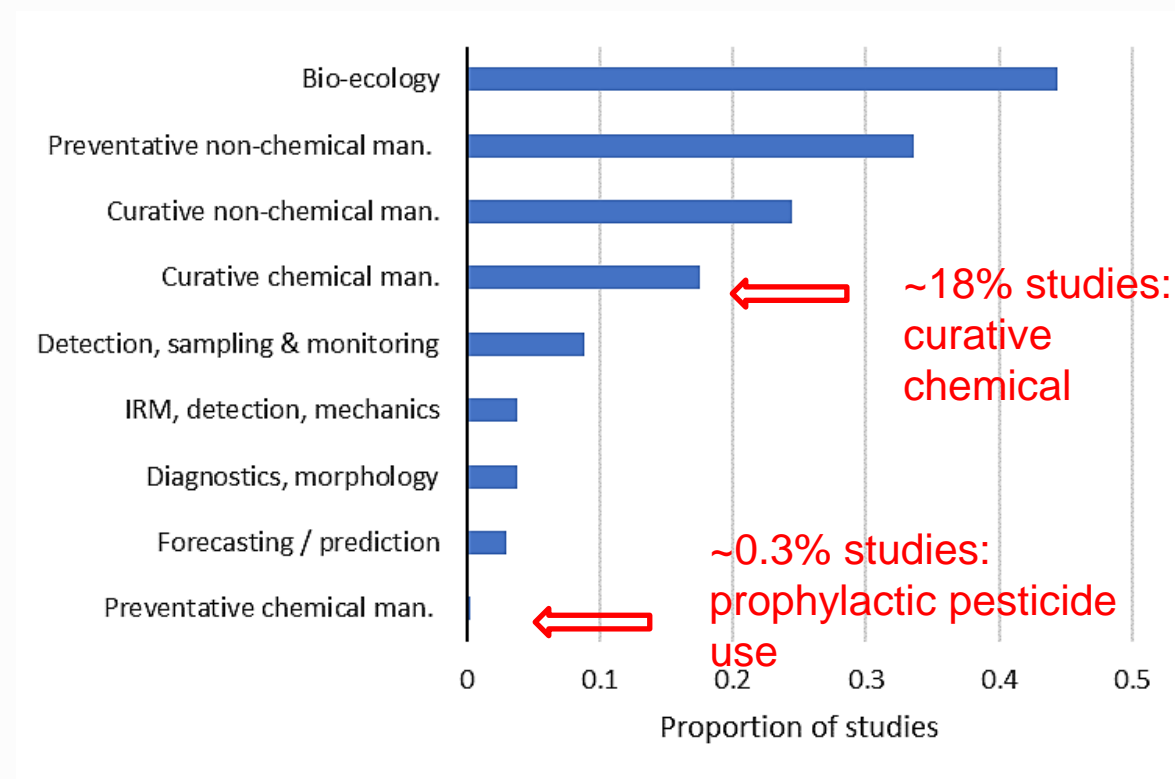
Key attention to non-chemical measures

Biological control covered in 1/3 studies

Host plant resistance (8%)

Botanical insecticides (6%)

Minor attention: SIT (1%), decision thresholds (0.5%), preventative chemical e.g., seed coatings (0.3%)





10%

Companion biota

Herbivore
(5%)

Plant
disease
(4%)

Non-crop
plant (8%)

Soil-dweller
(3%)

Target
pest
(81%)

Beneficial organisms

Vertebrate
predators (1%)

Pollinators (2%)

Invertebrate
predators (17%)

Invertebrate
parasitoids (16%)

Beneficial
microbes (9%)

Viruses (1%)

Landscape

7%

Farm

Field boundaries (3%)

Field

Inter-/intra-specific diversity (6/0.2%)
Rotation schemes (1%)

Seed

Crop genetics / phenology (21%)

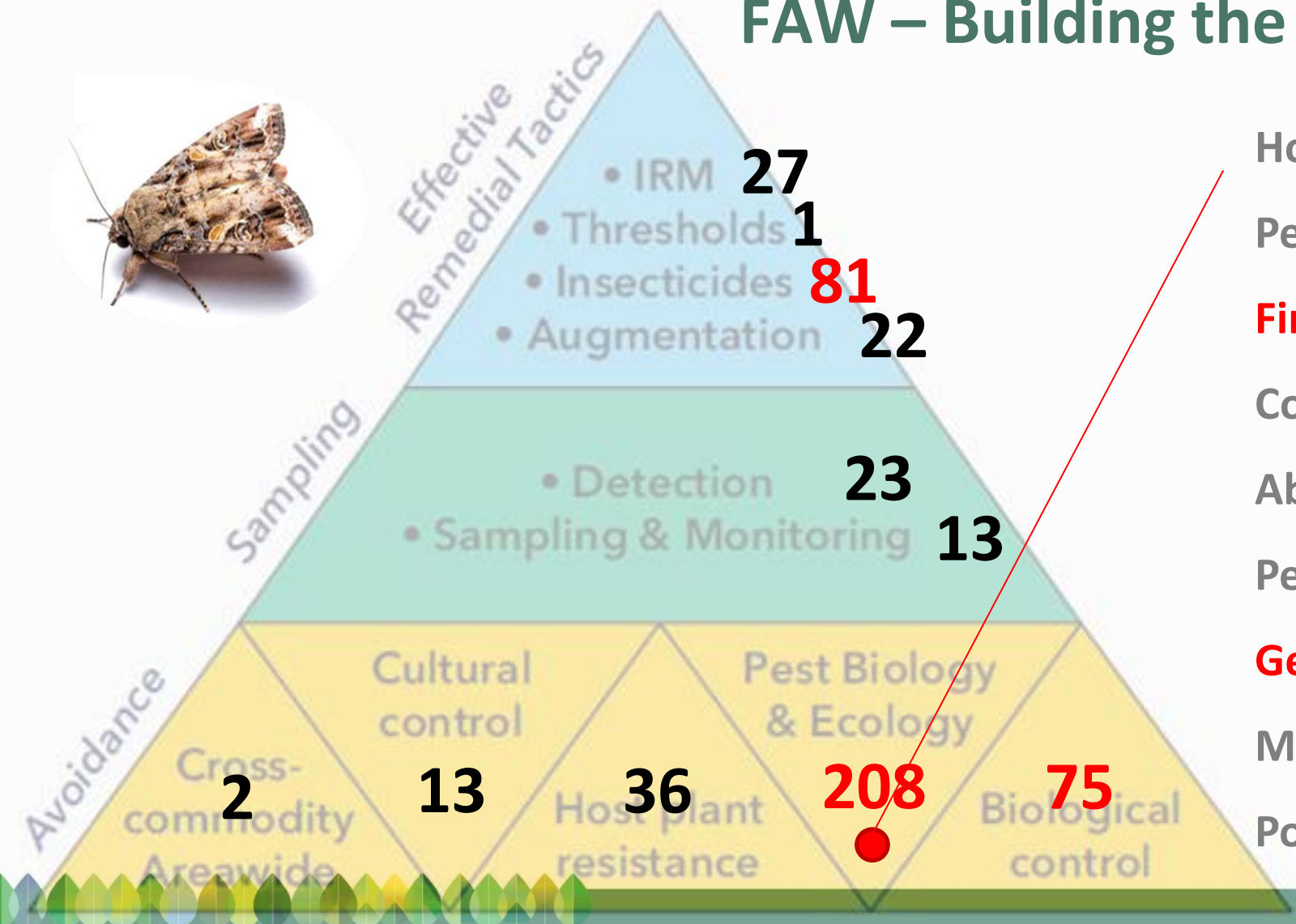
Soil

Soil fertility (3%)
OM addition (3%)
Tillage regimes (2%)

Field and
semi-field studies only
(N= 1,832)

Graphics from Wyckhuys et al.,
2022

FAW – Building the IPM solutions package



Host plant interactions: 26

Pest behavior: 19

Fine-resolution genetics / physiology: 91

Community-level interactions: 28

Abiotic determinants: 24

Pest growth / development: 31

Geographical distribution: 33

Morphology: 10

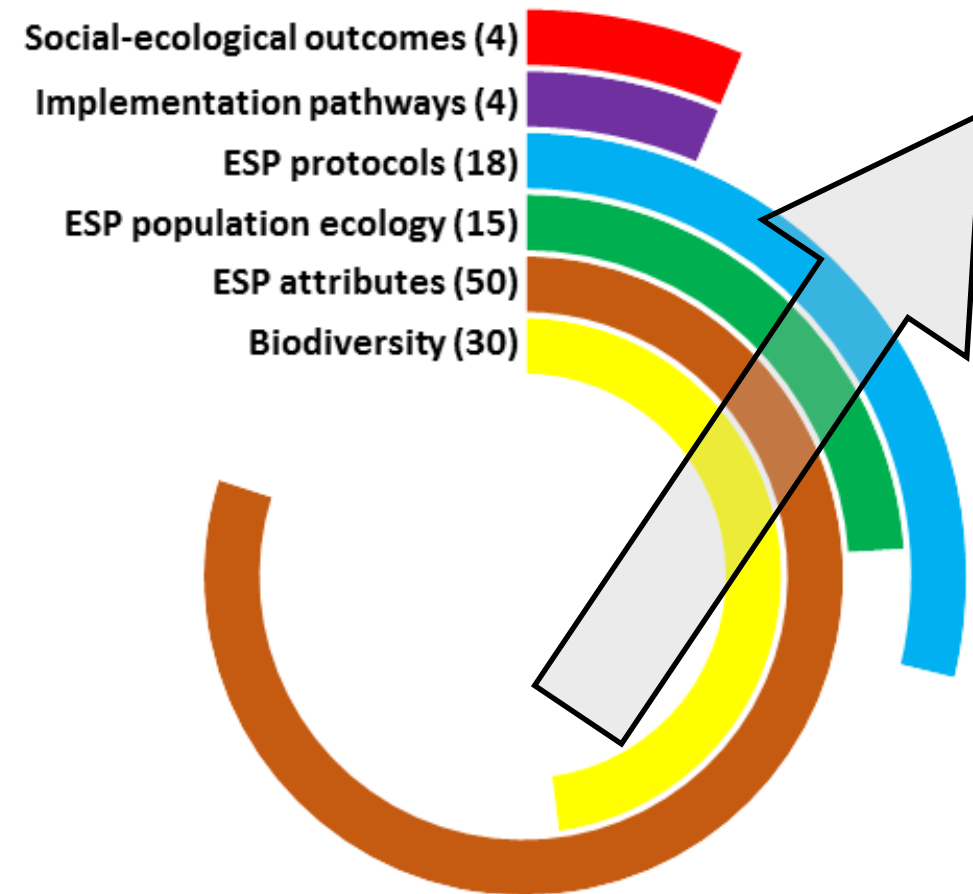
Population phenology: 9

As per Naranjo et al., 2019



FAW – Harnessing biodiversity

- 94 studies (**24%**) seek ways to harness biodiversity for pest management
- Relative progress along a **6-step pathway** from biodiversity discovery/description to assessment of its actual social-ecological outcomes
- Majority of studies finds themselves at **initial steps of the pathway**



As per Gonzalez-Chang et al., 2020; Wyckhuys et al., 2020



FAW research – Regional comparisons

Africa + NENA

42 out of 203 (21%) FAW-related papers cover Biocontrol

Parasitoids (28 pubs), microbes incl. nematodes (10), predators (7), viruses (2)

BC covered by 18/31 countries that published FAW research

Top-3 countries conducting FAW BC science: Kenya (13 pubs; 32% national output), Benin (5; 31%), Ghana (5; 31%)

Asia-Pacific

50 out of 320 (16%) FAW-related papers cover Biocontrol

Parasitoids (17 pubs), microbes incl. nematodes (15), viruses (14), predators (9)

BC covered by 7/18 countries that published FAW research

Merely 2 (!) papers from SE Asia

Top-3 countries conducting BC science: China (25; 13% national output), India (16; 31%), South Korea (3; 23%)





Global mapping of plant health initiatives: Key messages

Crop:

Fortify focus on vegetables, legumes, (tropical) fruits, forages

Maintain emphasis on cereal grains

Pest:

Balance emphasis on recent invaders with long-term endemic threats

Incentivize holistic crop protection science i.e., covering pest / pathogen / weed constraints

Strengthen existing consortia e.g., on priority threats

Geographic:

Consolidate basic capacity in Africa

Mobilize national expertise in LAC, NENA, SE Asia

Thematic:

Most research outputs focus on the pest per se, with relatively few taking into account broader variables (companion plants, natural enemies, etc.)

While there is a relatively high proportion of research outputs on biocontrol, this stands in contrast with relatively low adoption in the same countries

More research needs to be done on variables driving scaling up on biocontrol