Global Barriers and Facilitators to the Uptake of Biopesticides

Joint CABI and FAO evidence synthesis

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Ivy Saunyama and Melanie Bateman, June 2025

FAO and CABI partnership

Food and Agriculture Organization of the United Nations

A long-standing collaboration that supports:

- Smallholder farmers in low- and middle-income countries
- Sustainable and resilient crop production systems
- Global food security

Strengthened by a 2023 MoU focused on:

- Evidence synthesis
- Extension advisory services
- Science communication

Joint activities and achievements

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- Regional workshop on '*Advancing Regulatory Harmonisation and Biopesticide Innovation in Africa*' co-organised by CABI, FAO, AU-IAPSC, ICGEB, USDA FAS, CropLife Middle East and Africa, the WTO STDF, the African Food Safety Initiative, and the National Research Foundation
- Collaboration on the CABI BioProtection Portal
- Co-organised an open-ended workshop to promote the sustainable use of microbial and invertebrate BCAs and microbial biostimulants
- Collaborated on the BRS COP side event on biodiversity friendly alternatives to HHPs
- As part of the Juno Evidence Alliance, joint evidence synthesis to identify global opportunities and barriers to the uptake of biopesticides

FAO Partnership Award

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Objective: recognize and reward the efforts of noteworthy and effective partnerships that contribute to achieving sustainable development.

Nomination used examples from PlantwisePlus to meet the criteria:

- Demonstrating **raised visibility** of the problem of hunger and malnutrition
- **Communicating** complex agricultural and economic issues to the wider public, and
- Promoting **successful solutions** for improved food security.

Follows longtime engagement with FAO, including **MoU in October 23** to collaborate on R&D and agricultural advisory services, and lead joint activities on early warning for pest outbreaks and on pesticide risk reduction.

Evidence synthesis overview

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- **Problem statement**
  - Despite growing global interest, biopesticide use remains limited compared to synthetic pesticides
- **Research questions:**
  - What research exists on **barriers** and **facilitators** to biopesticide uptake?
  - What are the **barriers** and **facilitators** to biopesticide uptake and where do they occur along the stages of the uptake pipeline?
  - How do they vary by biopesticide **type** (e.g. microbial, macrobial), literature type and **geography**?

Types of biopesticides

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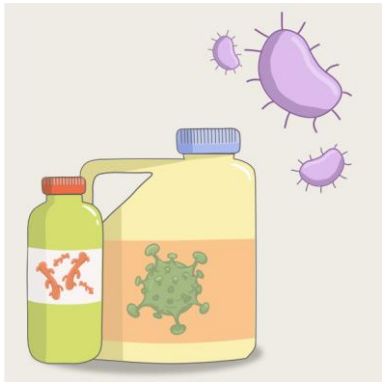
Biopesticides in this study are defined as: A pesticide containing active substances made from living or dead microorganisms such as bacteria, algae, protozoa, viruses and fungi, pheromones and other semiochemicals, and plants or parts of plants, designed to repel, destroy or control any pest or regulate the growth of plants. (Codex Alimentarius, 2022)



Microbials and their extracts

Macrobials (augmentative biocontrol)

Semiochemicals

Botanicals and other natural substances

Scope of the study

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- **Geographical scope:** Global
- **Timeframe:** 2016 – present; in line with the publication of the FAO guidelines for the registration of microbial, botanical and semiochemical pest control agents (FAO and WHO 2017)
- **Population:** Biopesticides
- **Intervention:** the 7 stages of biopesticide production and uptake pipeline
- **Phenomenon:** Contextual barriers and facilitators across stages
- **Literature type:** Academic and grey literature

Biopesticide production and uptake pipeline

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- Development and formulation
  - Optimizing product formulation
  - Optimizing biocontrol agent rearing
- Commercial production
  - Scaling production for market readiness
  - Ensuring cost-effectiveness
- Farmer uptake and adoption
  - Practical use by farmers
  - Ensuring technical support
- Research and discovery
  - Identifying new biological control agents
  - Determining mode of action and efficacy
- Regulatory approval
  - Registration requirements
- Market introduction and distribution
  - Responding to consumer demand
  - Improving biopesticide availability
- Long-term use and feedback
  - Evaluating sustained effectiveness and yield benefits

Approach

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		Academic literature	Grey literature
1. Data extraction	• Define search string (biopesticides, barriers, facilitators, timeline etc.) • Search academic databases (e.g. CAB Abstracts, Scopus, Web of Science) and grey literature websites (FAO, CABI, IBMA, UNEP, ICGEB, OECD, APAARI, STDF)	19,806 abstracts	922 other documents
2. Screening	• Remove duplicates • Check consistency • Sub-sampling and screening of abstracts	• 250 abstracts • 1,390 → 343	• 143
3. Synthesis	• Abstract labels for barriers and facilitators served as the basis for full text analysis • Full text labelling • Grouping labels by theme (55 themes)	75 articles	55 documents
4. Analysis and reporting	Underway		

Research distribution by stage and literature type

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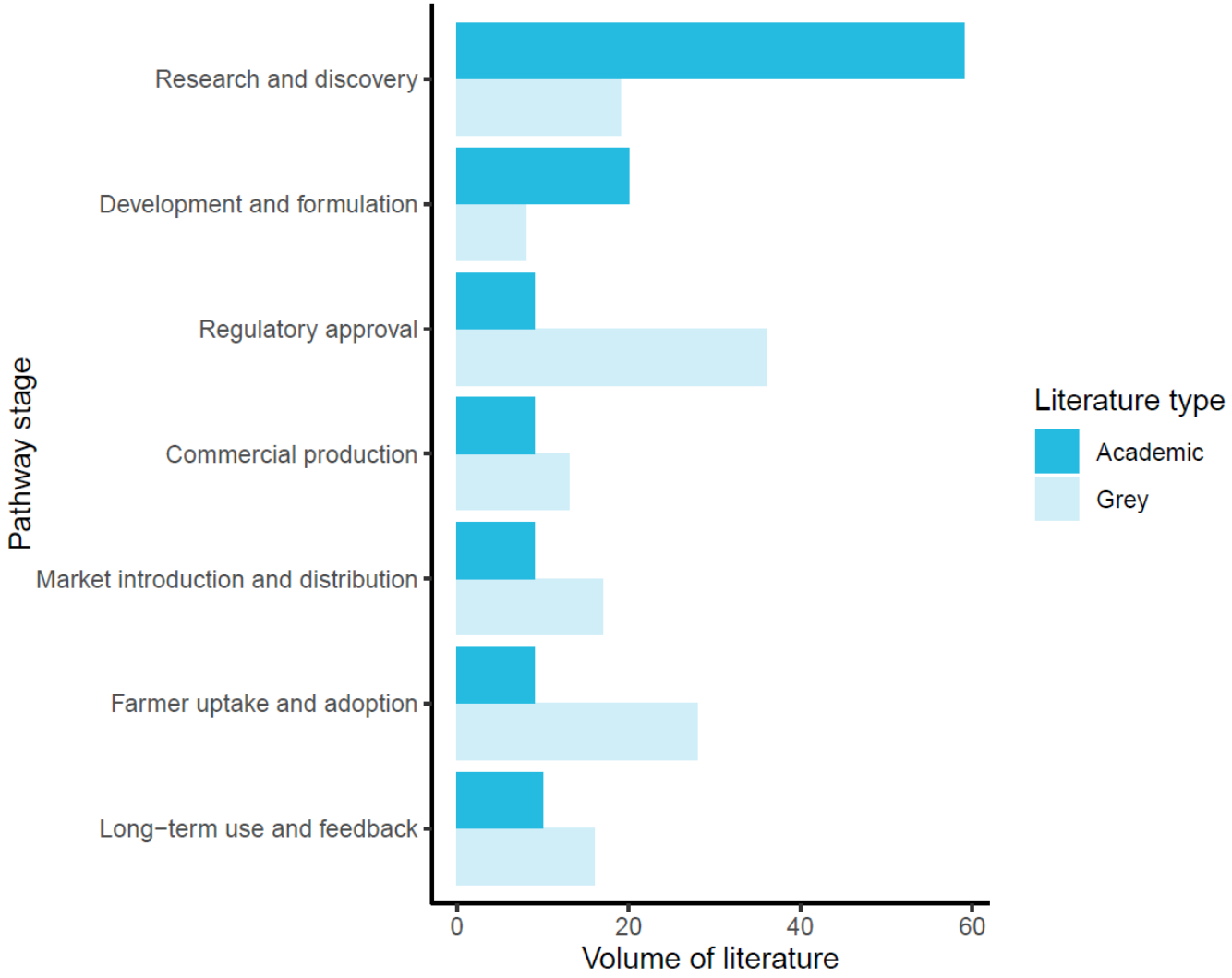
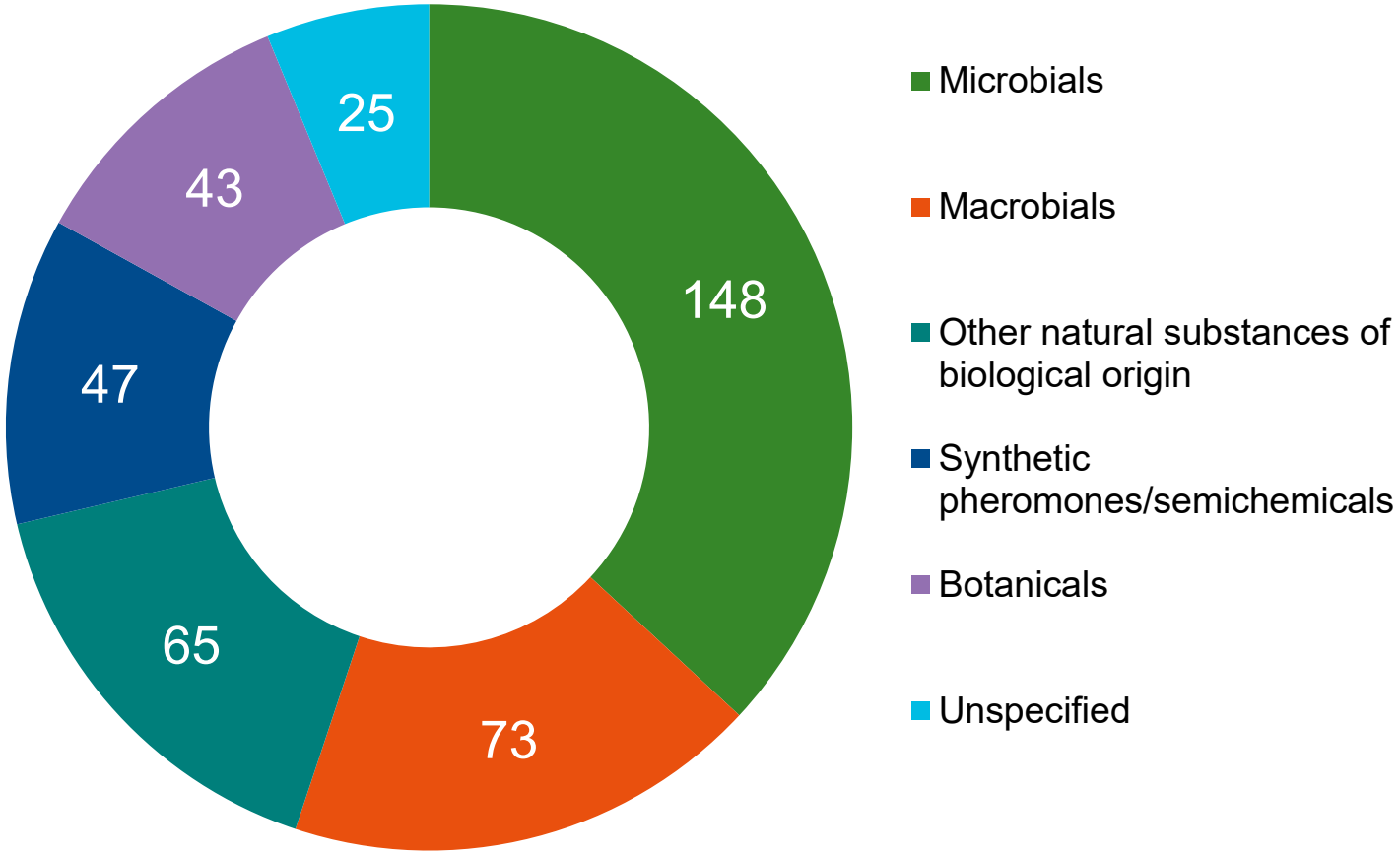


- Vast majority of **academic literature** focuses on the early stages of development
- **Grey literature** gives more attention to regulatory approval and farmer uptake
- The transitional **commercial production** and **market introduction** stages have limited literature, likely due to private sector domination
- Overall research **skewed** to the early stages, highlighting a need for more systematic and interdisciplinary work, addressing regulatory, commercial and long-term dimensions of biopesticide uptake

Variation of research (grey + academic) by biopesticide type



- **Microbial (148)** biopesticides are the most researched, possibly due to their commercial relevance, diversity and regulatory precedence
- Moderate attention to **macrobials (73)** and **semiochemicals (47),** possibly due to macrobial use being largely restricted to greenhouse systems and semiochemicals to specific crop-pest combinations
- Studies on **botanicals** may be published in regional journals and in local language, reducing their visibility in global systematic reviews

Variation of research by geographical scope of literature

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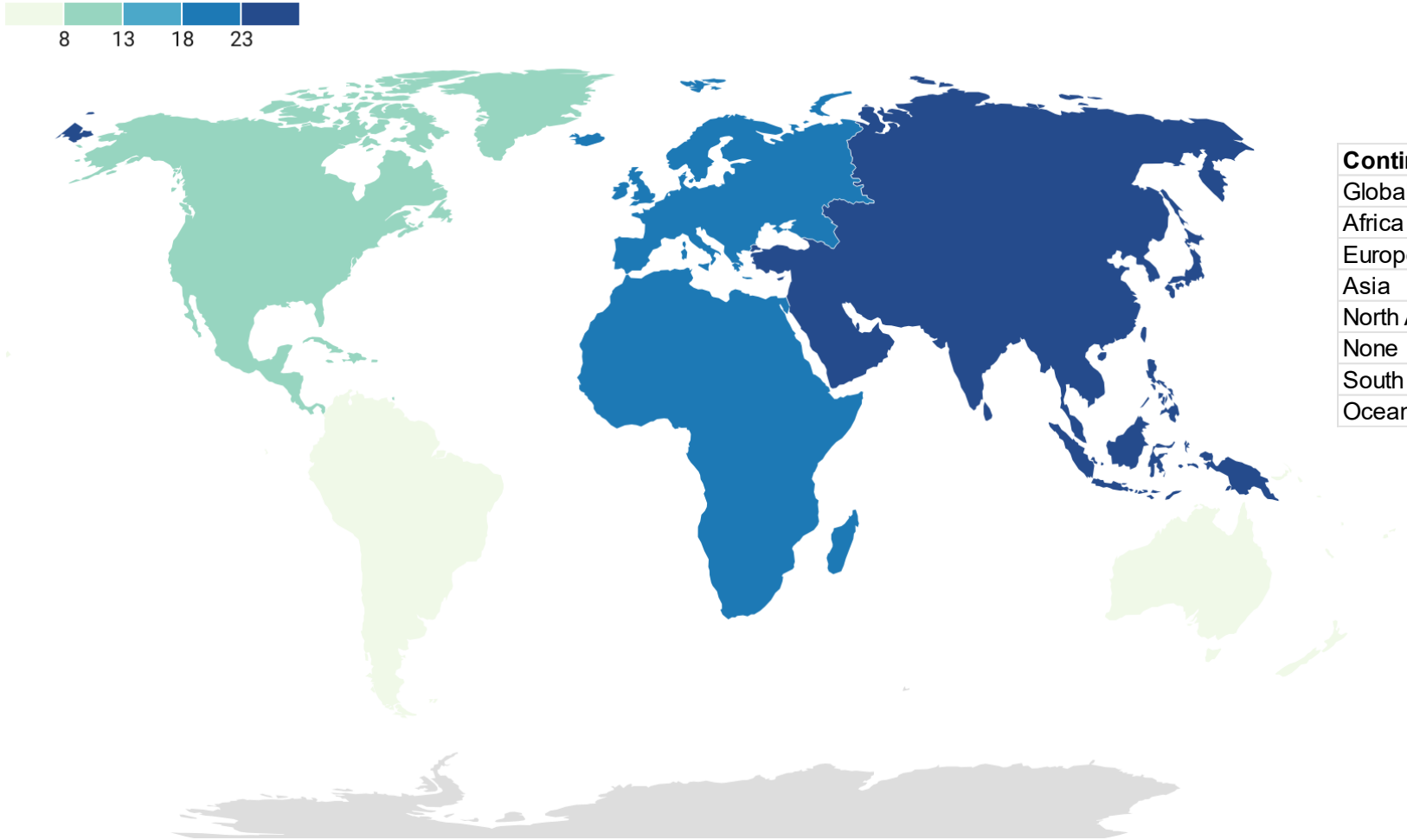
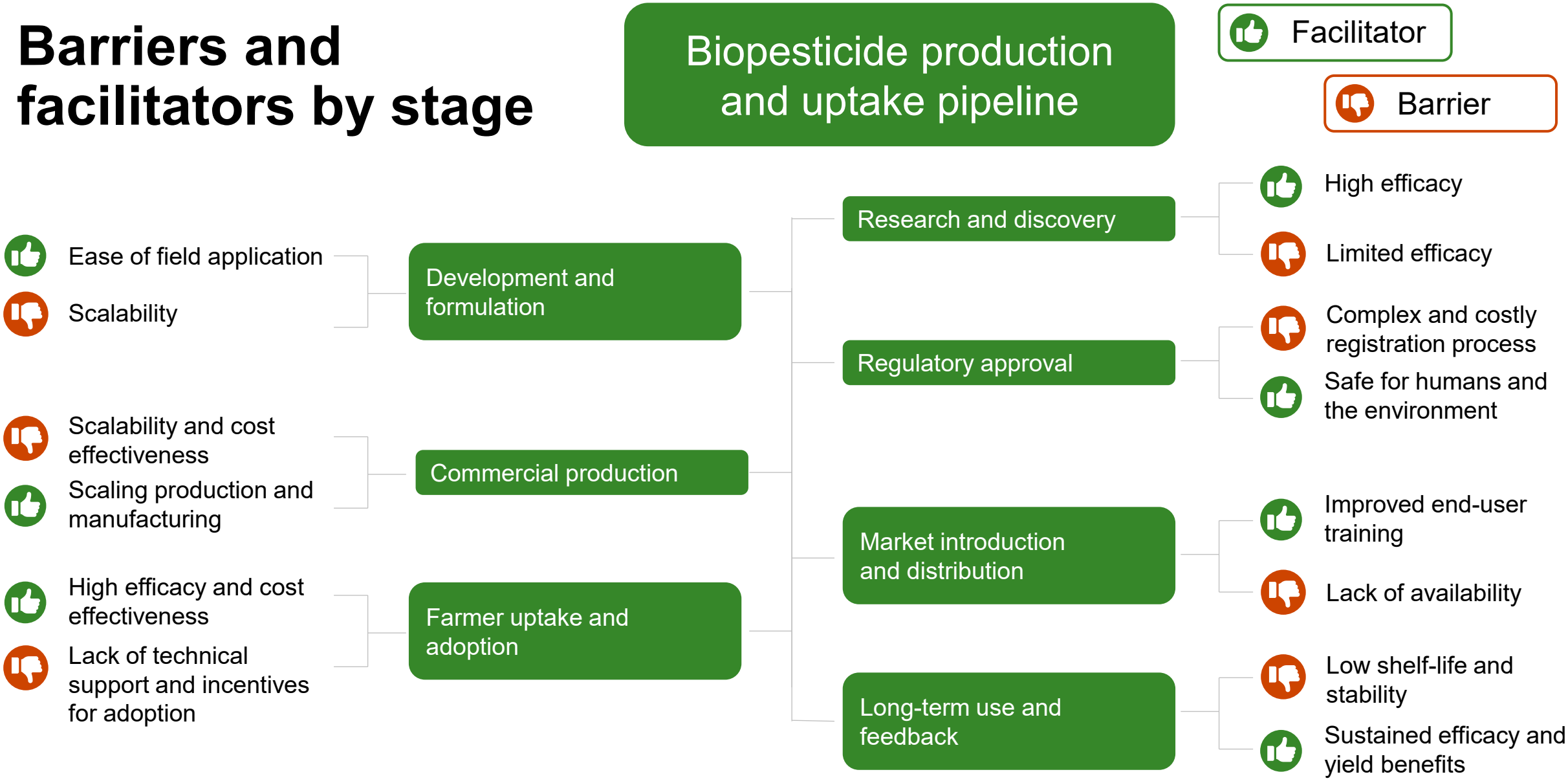


Continent	Grey literature reports	Academic articles
Global	17	28
Africa	11	7
Europe	9	9
Asia	8	20
North America	5	6
None	4	1
South America	1	4
Oceania	0	3

Barriers and facilitators by stage



Key takeaway messages

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- Large discrepancies by **literature type:**
  - **Academic literature** more geared towards research and discovery
  - **Grey literature** focuses on regulation and farmer uptake
  - Overall literature is skewed to the **early stages** of development, highlighting the need for more interdisciplinary work
- **Global trends** dominate the literature, suggesting largely common biopesticide barriers and facilitators across geographies
- Strong focus on **microbial** biopesticides across the literature suggests an advanced commercial relevance
- Efficacy, safety, scalability, end-user training and policies and institutions are some of the most common **limiting factors** to biopesticide production and uptake

Next steps and outputs

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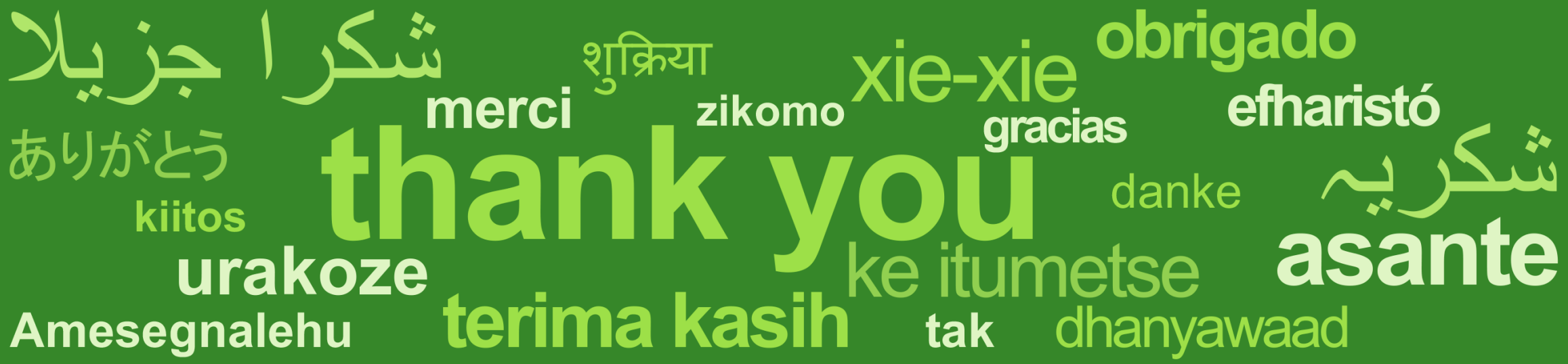
CABI-FAO next steps and outputs:

- Conclude screening and data analysis
- Scientific paper
- Evidence-based **policy brief** published by FAO to provide recommendations that help countries:
    1. Overcome the identified barriers and
    2. Implement facilitators to biopesticide production and uptake



CABI as an international intergovernmental not-for-profit organization, gratefully acknowledges the generous support received from our many donors, sponsors and partners. In particular we thank our Member Countries for their vital financial and strategic contributions.