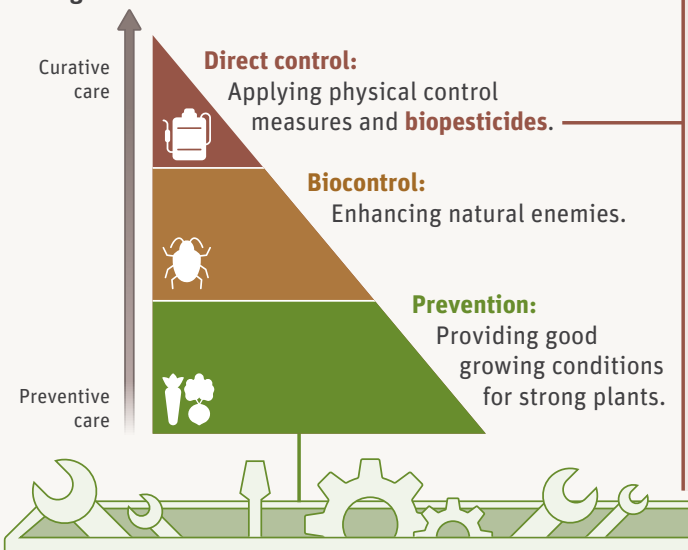
Biopesticides Beyond the Hype

A checklist to develop a locally-led, agroecologically-rooted biopesticide sector

The growing biopesticide market represents a pivotal opportunity for sustainable agriculture in the Global South. Rising environmental awareness, regulatory pressures on synthetic pesticides, and consumer demand for healthier food systems are driving innovation, investment, and regulatory adaptation in the sector. However, without careful alignment to agroecological principles, the biopesticide industry **risks repeating structural and ecological pitfalls** seen in the synthetic pesticide sector—such as corporate concentration, input dependency, lack of contextual adaptation, product uniformity and the persistence of pest management systems disconnected from ecosystem-based pest regulation. This might lead to reducing biopesticides to a "green substitute" rather than a catalyst for systemic change.

This guidance brief envisions biopesticides not merely as technological substitutes, but as complementary tools within integrated pest management and as catalysts to foster **locally-driven, decentralized, and contextually relevant innovation**. An agroecologically-rooted approach emphasizes local innovation, equity, and ecological integrity—**empowering small and medium-sized enterprises, farmers, and research actors to co-create solutions adapted to local contexts**. By embedding diversity, inclusivity, and environmental safeguards into regulation, investment, and market development, countries in the Global South can shape a biopesticide sector that supports a just and climate-smart food system—one that strengthens livelihoods, respects biodiversity, and avoids the concentration of power that undermines sustainable progress.

In agroecological systems, biopesticides are complementary ecological tools within sustainable pest management strategies



Definition:
Biopesticides are pest control agents derived from natural materials (e.g. animals, plants, fungi, microorganisms, certain minerals) used to manage pests. Although the term is widely adopted, an internationally standardized definition has yet to be established.

Level of investment required for different biopesticide models:

High — **Industrial scale biopesticides:**
- Require intensive R&D, standardized production, impact assessment and full regulatory validation.
- Advanced microbial or RNAi-based biopesticides.

Moderate — **SME-level biopesticides:**
- Semiochemicals (e.g. pheromone traps, lures) or simple microbial formulation (e.g. *Trichoderma*) requiring moderate technical capacity, facilities, and some regulatory oversight.

Low — **Farmer-produced biopesticides:**
- Natural plant extracts and botanical formulations (e.g. neem oil) using locally sourced materials and local knowledge.

Toolbox for preventive care against pest outburst:
Promote agroecological practices, working in synergies, that create a functional and diversified ecological system at the farm and landscape levels (e.g. weeding, crop diversity, soil tillage, flower strips, crop rotation, compost application, mulching, water conservation technologies and habitat management).

Biopesticides should strengthen the resilience of farming landscapes by complementing, not undermining, agroecological practices, contributing to ecosystem services and supporting biodiversity. In particular, they should:
- Improve soil health and beneficial microbes.
- Be target-specific to reduce collateral damage on beneficial organisms (e.g. on pollinators, decomposers, predators).
- Protect water and air quality.

Checklist: Four action areas to consider when developing a biopesticide sector

☑ This checklist offers practical guidance for aligning **biopesticide development with agroecological principles.** It outlines overarching concepts to guide (a) **policy makers and regulators** involved in agricultural inputs and agroecology policies, (b) **agroecological advocacy actors** advancing national policies, products, and innovations, (c) **investors and funders** seeking to support the growth and innovation of the sector.

1. Environmental and human health

☑ Prioritise **biodiversity-friendly solutions,** such as biopesticides that preserve natural predators, beneficial species and soil biota.

☑ Focus on solutions with low or well-known environmental and health risks (e.g. low toxicity, non-GMO-based products, non-persistent products) and apply **precautionary principles.**

☑ Support **crop diversification** by ensuring biopesticides are adapted to diverse, local, traditional, or orphan crops rather than being developed exclusively for major crops.

☑ Promote **circular and resource-efficient production of biopesticides** by incentivizing the use of locally sourced materials (e.g. agricultural residues, household waste, brewery by-products) and supporting closed-loop systems that connect biopesticide development with other agroecological enterprises.

☑ Integrate biopesticides into broader **landscape-level pest management strategies** and Integrated Pest Management (IPM) frameworks, recognizing their complementary role within diversified agroecosystems rather than as stand-alone inputs.

3. Local entrepreneurship and economies

☑ Support **locally-developed and locally-led enterprises** (ranging from subnational to regional scope), including SMEs and cooperative-based business models, for instance, through funding incubators and accelerators.

☑ **Incentivize social entrepreneurship** by supporting business models involving youth, local communities, and gender considerations through targeted government and private investment support.

☑ **Scale up demand** and **create market incentives for national enterprises:** for instance, prioritize procurement from SME-produced biopesticides in public programs and extension services.

☑ Promote a territorial, national or regional biopesticide sector to build resilient and diversified supply chains, and **reduce dependency on imports.**

☑ Ensure **competition policies and anti-trust regulations** prevent corporate capture and market monopolies by regulating mergers and acquisitions by external large agribusinesses, supporting regional competition authorities, and protecting SMEs from unfair international acquisitions or imports.

Transformational ← → **Incremental**

2. Farmer-centered approach

☑ Promote **decentralised development and distribution systems** that ensure democratic access (e.g. solutions that empower farmer cooperatives to serve as distribution networks, making market access and last-mile delivery more efficient).

☑ Ensure the **coexistence of farmer-produced botanical pesticides** (replicable, open-access formulation) and **private-sector produced products.**

☑ During product design, consider **smallholders' barriers and capital constraints**, ensuring products are compatible with the realities of small-scale farming, including available labour, farm equipment, storage facilities, irrigation systems, and local land tenure arrangements.

☑ Prioritize **cost-effective and reliable solutions** with low production costs and stable performance, ensuring affordability for farmers and reducing economic risks through predictable and proven effectiveness.

☑ Foster development of biopesticide innovations and testing **in collaboration with farmers,** integrating their local knowledge and constraints.

☑ **Strengthen farmer training and knowledge exchange** on biopesticide production and use by embedding programs within farmer-to-farmers networks and extension services to build local expertise and trust.

4. Context-specific regulation

☑ Ensure a **sound monitoring and control system** is in place to detect and respond to potential abuses and to build trust in the biopesticide sector (e.g. clear accountability measures and enforcement protocols).

☑ **Develop adapted and differentiated regulatory mechanisms:** for instance, consultative regulatory mechanisms to evaluate and approve biopesticides based on the nature of the product (e.g. botanicals), reduced bureaucratic costs related to registration/homologation for SMEs.

☑ Strengthen **transparency and traceability** of the origin, composition, efficiency and impacts of bioinputs (e.g. through participatory certification, locally accessible platforms).

☑ Ensure that locally developed biopesticides are **rigorously tested for safety,** with **clear protocols** to prevent risks to human and animal health, especially under conditions of improper use or exposure.

Case Study: RealIPM – A Regional Leader in Farmer-Centered Biopesticides

RealIPM, founded in Kenya in 2003, stands as a powerful example of how locally rooted, commercially viable, and agroecologically aligned biopesticide enterprises can scale in Africa. As a result of its successful growth, the company opened additional offices in Uganda and Tanzania in 2016. Today, it operates across multiple African countries, employs 300 people and established itself as a **regional champion in the development and deployment of integrated pest management** (IPM) solutions tailored to smallholder needs.

RealIPM offers a wide range of residue-free biological solutions, including fungal biopesticides, pheromone traps, beneficial insects and predatory mites, all designed to reduce dependency on synthetic pesticides. Their IPM strategy emphasizes **preventive, ecosystem-based approaches** complemented by curative biopesticides products to be used at last resort, making pest management both sustainable and effective.

RealIPM's achievements have been made possible through **strategic partnerships** (e.g. their PROSAFE initiative on innovative product development and commercialization). Besides, collaborations with research institutions like ICIPE (International Centre of Insect Physiology and Ecology) provide scientific rigor, while alliances with agro-dealers, industry and extension networks ensure that products reach remote farming communities. This integrated model bridges the gap between research, production, and farmer adoption. Far from being a niche player, RealIPM has demonstrated a strong business case for biopesticides. The company has grown through market-driven solutions that align profitability with sustainability, complementing product sale by efficacy and residue trial services, as well as consultancy and trainings. Its success underscores the potential for local SMEs to scale bio-inputs without compromising environmental or social values.

An agroecologically-rooted vision among various food system transition pathways

A diversified biopesticide sector is essential to support multiple food system transition pathways - ranging from the phasing out of the most hazardous pesticides, gradual substitution approaches in conventional systems to their integration within holistic agroecological systems – adapted to different scales and capacities of farmers.

An agroecology-aligned vision emphasizes biodiversity, crop diversification, and integrated pest management (IPM), rather than replacing synthetic pesticides one-for-one with biopesticides. It is embedded in systemic change and fosters a decentralized, nationally driven bioinput sector that empowers farmers, SMEs, and local innovators (especially among youth).

Key recommendations

1. **Promote national and territorial bioinput strategies.** Build local biopesticide value chains through market incentives, social entrepreneurship, and public procurement policies, and link these strategies to broader agroecological transition plans, Nationally Determined Contributions (NDCs), and national sustainability goals.
2. **Design differentiated and progressive regulatory pathways.** Create differentiated registration or approval procedures **depending on** the risks and complexity of the biopesticide, and scale of its use.
3. **Develop context-specific transition pathways.** Tailor biopesticide and pest management solutions to farmers' realities and stages of transition. Identify priority regions where replacing highly hazardous pesticides can have the greatest impact.
4. **Invest in local capacity and infrastructure.** Support small and medium enterprises (SMEs) in formulation, biomanufacturing, and quality control. Guarantee access to funding and markets for emerging local actors.
5. **Ensure biopesticides are developed and deployed as complementary tools.** Embed biopesticides within integrated pest management and agroecological systems, supporting biodiversity, ecosystem services, and soil and water health rather than functioning as stand-alone substitutes for synthetic pesticides.

biovision

Interested in the topic?

Find more information on Biovision's work around bioinputs:
https://www.biovision.ch/infopool/bioinputs/