

ANNEX 1 • FINAL VMG NATIONAL SYNTHESIS REPORT

Crop Protection and the Transition towards Agroecological and Preventive Approaches in Egypt

Current status, barriers, opportunities and priority actions

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DECISION BRIEF

Executive summary

Egypt needs a crop-protection transition that reduces pesticide dependency and risk while protecting yield, farm income, food safety and export compliance. The strongest pathway is not abrupt chemical withdrawal. It is the redesign of cropping systems so that water stress, soil and root health, canopy microclimate, pest surveillance and biological regulation prevent outbreaks; selective chemistry then remains a justified last-resort or quarantine tool. This direction aligns with COST Action CA21134, Egypt's Updated Sustainable Agricultural Development Strategy 2030 and OECD recommendations to reinforce pesticide governance, advisory services and farmer-centred innovation [1–3].

Headline finding

Egypt already has important building blocks—pesticide registration and surveillance, accredited residue testing, national monitoring, Farmer Field Schools, research capacity, digital-extension initiatives and crop-specific low-residue practice. The limiting factor is coordination: evidence, advice, incentives, regulation and market signals do not yet operate as one transition system.

Five conclusions for action

1. Adopt risk- and dependency-reduction as the operational objective, with zero-pesticide systems treated as a crop- and context-specific long-term direction rather than a universal short-term promise.
2. Prioritise prevention packages—water and salinity management, healthy planting material, resistant varieties, rotations, sanitation, canopy design, habitat management and soil biological function—before input substitution.
3. Make decisions measurable through scouting, traps, weather and crop-stress indicators, action thresholds, resistance-management records and residue intelligence.
4. Scale co-designed demonstration networks that combine researchers, extension, farmers, regulators, laboratories, exporters and input/technology providers.
5. Track agronomic, economic, environmental and compliance outcomes together; pesticide reduction without yield, cost, water and market indicators is not a credible transition metric.

Scope note. This final synthesis integrates authoritative policy, regulatory, monitoring and scientific evidence with practitioner perspectives obtained through five VM consultations. Consultation input was used to test feasibility, refine crop priorities and strengthen the implementation roadmap; perceptions were triangulated against published and official evidence.

EVIDENCE AND ACCOUNTABILITY

1. Purpose, scope and method

The report provides a concise national synthesis for the TOP-AGRI-Network: the present crop-protection situation in Egypt; the potential of integrated pest management (IPM), biological control and preventive agroecological design; implementation barriers; relevant programmes; and mechanisms for engaging farmers and public authorities. It is intended to guide Action coordination, future exchanges and practical capacity building—not to substitute for a national pesticide-risk assessment or crop-specific protocol.

1.1 Evidence approach

Evidence was prioritised in the following order: (i) official Egyptian policy, regulatory and laboratory sources; (ii) FAO, OECD and COST materials; (iii) peer-reviewed Egyptian monitoring and field studies; and (iv) practitioner evidence from the applicant's earlier national success-story presentation. Claims are interpreted conservatively: residue detection is not equivalent to unsafe food; a local market survey is not a national prevalence estimate; and registered biological products are not proof of field efficacy in every production context.

Evidence stream	What it contributes	Limitation / treatment in this report
Official sources	Policy direction, pesticide registration, residue-testing and extension infrastructure.	May describe mandates or activities without reporting adoption or impact.
Monitoring studies	Crop-specific residue occurrence, compliance patterns and cumulative-exposure evidence.	Sampling frames and years differ; results are not merged into one national rate.
Consultations	Operational constraints, incentives, feasible actions and stakeholder priorities.	Documented in Section 1.2; perceptions are triangulated against official and scientific evidence.
Practice case	System logic linking water, root health, canopy, monitoring and targeted intervention.	A transition hypothesis until crop- and site-specific outcomes are measured.

1.2 VMG consultation record

VMG CONSULTATION RECORD

Period and format: 11–15 September 2026; focused online discussions with telephone and written follow-up. Participants (n=5): Mounir Haddad (private-sector leadership and market perspective); Mohamed Gomaa (crop-protection research and IPM); Ramy El Behery (agricultural advisory, extension and farming); Tarek Soliman (public-sector, regulatory and agricultural-development perspective); and Mohamed El Geziery (biological crop protection and technical implementation). Consensus: reduce pesticide dependency progressively; prioritise prevention, monitoring and threshold-based decisions; validate biological products locally; and pilot integrated packages in grapes, strawberry and citrus. Remaining concerns included costs, technical capacity, data availability and biological-product consistency. The feedback strengthened the prevention hierarchy, monitoring indicators, crop priorities and multi-actor roadmap.

Participants reviewed the national diagnosis, the feasibility of transition levers, crop priorities, implementation barriers, indicators and draft recommendations. Their perspectives were triangulated with official and peer-reviewed evidence. Because the activity was completed within a focused five-day VM, targeted discussions and asynchronous follow-up replaced several larger meetings without changing the planned synthesis.

WHY PREVENTION MATTERS

2. Egyptian production context

Egyptian agriculture operates under unusually tight water and land constraints. The OECD reports water availability approaching the 500 m³ per capita annual threshold and notes that the Nile Valley and Delta—about 4% of national territory—host roughly 95% of the population [2]. Heat waves, salinity, intensive rotations and protected cultivation can amplify crop stress and pest pressure. At the same time, domestic food security and high-value export chains require reliable output, traceability and compliance with destination-market maximum residue limits (MRLs).

These conditions connect crop protection to irrigation scheduling, drainage, nutrition, planting material, labour, advisory services and market governance. The practical unit of transition is therefore the production system, not a single replacement product. In FAO terms, IPM combines available methods to maintain healthy crops while minimising pesticide use and risk [4]. Agroecological prevention extends this logic upstream by shaping the crop environment so that outbreaks are less likely and natural regulation is more effective.

STATUS AND RISK SIGNALS

3. Current crop-protection situation

3.1 Use, governance and residue intelligence

The FAOSTAT series, as reported by Malhat et al. (2025), indicates that pesticide use in Egypt rose from 4,823 tonnes in 1999 to an estimated 9,469 tonnes in 2022, while application intensity increased from 1.38 to 2.33 kg/ha [5]. These aggregates signal growing dependence but do not describe crop, governorate, hazard class, application quality or exposure. They should trigger better disaggregation rather than a single national reduction claim.

The Agricultural Pesticides Committee (APC) evaluates and registers agricultural pesticides and regulates handling and use under Ministerial Decree No. 974/2017. Its public database and technical guidance provide a formal foundation for stewardship, enforcement and biopesticide development [6]. OECD nevertheless identifies implementation gaps and recommends stronger enforcement, certified-applicator training, dissemination of good practice and more capable extension and advisory systems for IPM [2].

Egypt also has substantial analytical infrastructure. The Central Laboratory of Residue Analysis of Pesticides and Heavy Metals in Food (QCAP), accredited to ISO/IEC 17025, reported analysing more than 97,000 food samples during the first quarter of 2025, including more than 17,000 export samples, 20,000 import samples and 3,000 samples within the national monitoring project [7]. This capacity can do more than verify compliance: anonymised, crop- and season-resolved trends could help target prevention, advice and surveillance.

3.2 What Egyptian monitoring studies show

Study / evidence	Interpretation for transition policy
Nationwide vegetables, 2018–2021	A survey of 4,200 samples demonstrates the value of multi-year, multi-crop surveillance and cumulative-risk assessment. It supports crop-specific intelligence rather than undifferentiated national messaging [8].
Eight vegetables, 2022	Among 6,534 samples screened for 430 residues, MRL exceedances varied by crop (2.96–9.75%); multiple residues occurred, while estimated chronic dietary hazard indices remained below safety thresholds. Compliance problems and dietary risk must therefore be communicated separately [5].
Dakahlia vegetables, 2018	In 176 samples, 63.1% contained detectable residues and 16.48% exceeded MRLs. This is a useful local warning and training case, not a national estimate. The study was supported by Egypt's Academy of Scientific Research and Technology (ASRT) [9].

3.3 Priority pest-management pressures

The consultations reinforced the need for crop- and region-specific priorities. Combined with available evidence and the applicant's practice synthesis, the discussions highlighted recurring combinations: powdery mildew, Botrytis and mealybugs in grapes; mites, Botrytis and soil-borne diseases in strawberry; fruit flies, scales, mites and gummosis in citrus; and anthracnose, arthropod pests and salinity-linked vulnerability in mango and olive. Fall armyworm and red palm weevil show the importance of surveillance, early warning and area-wide coordination.

Critical interpretation

The central problem is not simply “too much pesticide.” It is routine or poorly timed use within stress-prone production systems, uneven access to diagnosis and advice, resistance pressure, fragmented records, variable enforcement and market incentives that may reward cosmetic quality without rewarding prevention. Solutions must address this decision environment.

FROM CALENDAR SPRAYING TO PREVENTIVE CROP HEALTH

4. A practical transition model for Egypt

The resulting model is a decision hierarchy. Each layer reduces the probability or impact of pest outbreaks; later layers are used only when earlier prevention and monitoring do not maintain acceptable risk. The hierarchy should be adapted by crop, production system, governorate and market destination.

Layer	Core practices	Decision evidence / indicators
1. Prevent stress	Irrigation scheduling; salinity and drainage management; balanced nutrition; heat-risk planning; healthy planting material.	Soil moisture, EC, canopy temperature, plant-water status, nutrient balance and crop vigour.
2. Design the crop	Resistant/tolerant varieties; rotation; sanitation; canopy architecture; ventilation; sowing/harvest timing; habitat management.	Disease-conducive humidity, canopy density, inoculum sources, crop sequence and natural-enemy observations.
3. Build soil/root function	Quality compost and organic amendments; locally validated AMF, PGPR and Trichoderma; root-zone protection.	Root health, soil biological/function indicators, product quality control and replicated response evidence.
4. Detect early	Regular scouting; traps; diagnostics; weather forecasts; digital records; pest and disease models.	Pest density/incidence, phenology, forecast risk, hotspot maps and action thresholds.
5. Intervene biologically first	Conservation and augmentative biological control; microbial/biochemical products; mating disruption; mass trapping.	Efficacy, timing, compatibility, natural-enemy retention, cost and supply reliability.
6. Use chemistry precisely	Selective product; threshold-triggered and targeted application; dose/calibration quality; mode-of-action rotation; pre-harvest compliance.	Justification record, treated area, treatment frequency, resistance plan, residue result and re-entry/pre-harvest intervals.

4.1 Crop pathways suitable for demonstration

- Grapes: combine canopy ventilation, irrigation and nitrogen balance, weather-based disease risk, scouting and traps, biological/low-risk tools, then threshold- and resistance-guided chemistry. Thompson and Crimson seedless systems offer an export-relevant demonstration platform.
- Strawberry: begin with protected nursery hygiene and clean planting material; manage irrigation and humidity; strengthen root-zone health; monitor mites and Botrytis; evaluate biological options within short residue-sensitive production cycles.
- Citrus: integrate orchard hygiene, fruit-fly monitoring and area-wide action, scale/mites scouting, canopy and irrigation management, root health and traceable targeted applications.
- Mango and olive: reduce salinity and heat stress, improve canopy and sanitation, use phenology-based monitoring, and reserve targeted treatments for verified risk.

4.2 Role—and limits—of innovation

Precision agriculture can improve timing and spatial targeting through weather stations, sensors, satellite/drone imagery and digital scouting, but technology is useful only when connected to a validated decision rule and an adviser or farmer able to act. Beneficial microorganisms and biopesticides may strengthen prevention or control, but strain identity, formulation quality, storage, compatibility and local efficacy matter. “Biological” should not be treated as automatically effective or risk-free. Priority should go to independent validation, quality assurance and integration with agronomy.

Operational principle

Measure → prevent → monitor → act only when justified → learn from the result. Each intervention should record the pest risk, trigger, product or practice, cost, efficacy, non-target considerations and residue/market implications.

IMPLEMENTATION AGENDA

5. Barriers, enabling actions and metrics

Barrier	Why it slows transition	Priority enabling action
Fragmented knowledge and advice	Research, extension, laboratory, regulatory and market information may not reach farmers as one usable recommendation.	Create crop-specific multi-actor technical groups and harmonised decision guides; connect field records with residue and surveillance intelligence.
Uneven diagnosis and extension reach	Calendar spraying is rational when timely diagnosis, thresholds and trusted advice are unavailable.	Train advisers and lead farmers; expand Farmer Field Schools (FFS), demonstration plots, hotlines and Arabic mobile/voice content.
Short-term risk and economics	Prevention may require labour, equipment or learning before benefits are visible; crop failure risk dominates decisions.	Use shared demonstrations, transition grants/credit, service providers, buyer agreements and partial risk-sharing tied to verified records.
Biocontrol supply and quality	Variable availability, cold-chain/storage, shelf life, application timing and field performance undermine confidence.	Strengthen registration pathways, quality control, local production where viable, independent trials and stewardship training.
Regulatory and applicator gaps	Registration alone does not ensure correct purchase, calibration, protection, disposal, intervals or resistance management.	Scale certified-applicator systems, inspections, traceability, container management and retailer/adviser accountability.
Data fragmentation	Use, pest, weather, residue, resistance, cost and outcome data are held by different organisations and formats.	Agree a minimum national dataset, governance and anonymised dashboards; publish crop-season learning summaries.
Smallholder diversity and collective pests	Farm size, literacy, tenure, irrigation access and market channel shape feasibility; some pests cross farm boundaries.	Segment recommendations; use cooperatives, producer groups and area-wide surveillance/control for mobile or quarantine pests.
Market signal mismatch	Farmers may bear transition costs while benefits accrue to buyers, exporters, consumers or public health.	Reward documented practice and compliance through procurement, contracts, assurance schemes and premium/market-access mechanisms.

5.1 Minimum monitoring framework

A credible programme needs a baseline and comparison over at least one full crop cycle. Indicators should be reported by crop and production system, with unintended effects disclosed.

Dimension	Minimum indicators
Pesticide dependency and stewardship	Applications/season; kg active ingredient/ha where available; treatment frequency or treated-area index; share threshold-triggered; share biological/low-risk; mode-of-action rotation; calibration and PPE compliance.
Crop and ecology	Yield and marketable quality; pest/disease incidence; control failure; natural-enemy observations; soil/root and crop-stress indicators; water use where relevant.
Economics and adoption	Protection and labour cost/ha; gross margin; crop loss avoided; farmers/advisers trained; correct-practice adoption and continuation; service availability.
Food safety and markets	MRL compliance; multiple-residue pattern; rejected/held consignments; traceability completeness; destination-market access.

5.2 Staged roadmap

0–6 months: select 2–3 crop-region-market pathways; establish baselines; convene partners; agree protocols, safeguards and data ownership. 6–24 months: run replicated demonstrations and FFS cycles; publish seasonal learning briefs; improve diagnosis, input quality and advisory response. 24–48 months: scale only packages that maintain yield and margin while reducing dependency/risk; embed certified practice, market incentives and national dashboards. Independent evaluation should compare outcomes with matched current practice and explain where transition did not work.

BUILD ON NATIONAL CAPACITY

6. Existing programmes and partnership opportunities

Egypt does not start from zero. The immediate opportunity is to connect mandates and programmes around crop-specific transition pathways, while distinguishing public evidence from private claims.

Actor / initiative	Existing contribution	Opportunity for T0P-AGRI-Network
APC	Registration, regulation, public database, guidance and pesticide-use governance under Decree 974/2017 [6].	Dialogue on low-risk/biopesticide pathways, stewardship metrics, applicator capacity and evidence needs.
QCAP / MALR	ISO/IEC 17025 residue analysis, national monitoring, export/import testing and stakeholder training [7].	Translate anonymised crop-season residue patterns into preventive extension and demonstration priorities.
ASRT-supported research	A 2016–2018 project supported work on occupational pesticide effects, prevention and safe disposal; one Dakahlia residue study arose from it [9].	Map national projects systematically and connect research outputs to extension, regulation and longitudinal impact indicators.
FAO–MALR FFS	Forty facilitators from 16 governorates were trained for 20 fall-armyworm FFS; 225 farmers completed 11 red-palm-weevil FFS in four governorates [10,11].	Adapt the participatory model to crop-health packages, farmer experiments, records and peer learning.
Digital extension	MALR initiatives include the Hudhud smart farmer assistant, agricultural e-platforms and digital advisory activity [12].	Link validated alerts and decision trees to local advisers; evaluate reach, comprehension and action—not downloads alone.
Sustainable Pesticide Management Framework	A five-year multi-stakeholder framework was launched in 2024 under Ministry patronage, involving APC, QCAP, the Agricultural Export Council and industry [13].	Engage transparently on stewardship, training and data while maintaining independent evaluation and conflict-of-interest disclosure.

6.1 Participation and governance mechanism

A national transition platform should be light enough to act and broad enough to be trusted. A small steering group—MALR/APC, ARC/NRC/universities, extension, QCAP and farmer representation—can set priorities and safeguards. Crop pathway groups should include farmers and producer organisations, local advisers, biological and conventional input specialists, water/soil experts, exporters/buyers and digital-service providers. Consumer, worker-safety and environmental perspectives should be invited where relevant.

6.2 Practical engagement cycle

1. Listen and segment: interview farmers and advisers by crop, scale, governorate, irrigation condition and market channel; identify decision bottlenecks rather than only awareness gaps.
2. Co-design: define the farmer problem, feasible prevention package, action thresholds, responsibilities, costs and success/failure criteria before the season.
3. Demonstrate and compare: use paired or replicated plots, farmer records and field days at critical phenological stages; report labour and economics as carefully as pesticide counts.
4. Close the evidence loop: connect field observations, diagnostic results, weather, input use, efficacy and anonymised residue results; revise recommendations each season.
5. Institutionalise: convert validated practices into extension protocols, certified training, procurement/contract requirements, registration evidence priorities and national strategy reporting.

Safeguards

Participation must be voluntary and documented; personal and farm data require consent and proportionate access controls. Product trials should disclose funding and conflicts, use registered products and authorised rates, and report negative as well as positive results.

RECOMMENDED NEXT STEPS

7. Priorities and contribution to COST Action CA21134

7.1 Priority recommendations

1. Establish an Egypt crop-protection transition baseline that integrates pesticide-use practices, pest pressure, residue patterns, farm economics, water/stress conditions and advisory access by crop and region.
2. Launch two or three multi-actor crop pathway pilots—initial candidates are export grapes, strawberry and citrus—using the preventive hierarchy, explicit comparison practice and a shared minimum dataset.
3. Create a national learning interface between APC, QCAP, research organisations and extension so that regulatory, monitoring and field evidence produces timely, crop-specific advice.
4. Strengthen people and services: FFS facilitators, certified applicators, local diagnostics, sprayer calibration, biocontrol quality/stewardship and accessible Arabic digital decision support.
5. Align incentives through buyers, exporters, producer organisations and public programmes; reward verified prevention, traceability and outcome improvement while protecting farm viability.

7.2 Contribution to Action objectives and deliverables

This synthesis contributes to WG1 by identifying knowledge, data and implementation gaps; WG2 by framing a viable transition pathway and the roles of value-chain actors; WG3 by specifying where biological control, biopesticides and beneficial microorganisms require validation and enabling conditions; WG4 by defining redesigned crop-system pathways and comparable indicators; and WG5 by providing a national stakeholder-engagement and dissemination mechanism [1]. The report also offers candidate case studies, partners and metrics for future COST exchanges, Training Schools, Short-Term Scientific Missions and cross-country comparison.

Bottom line

Egypt can reduce pesticide dependency most credibly by making prevention, measurement and coordinated learning routine. The objective is not fewer applications at any cost; it is resilient crop health, justified intervention, safer work and food, viable farms and durable market access.

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