CONSORTIUM FOR
RED PALM WEEVIL
CONTROL

R4D Brief: Socioeconomic and Environmental Impacts of the Red Palm Weevil in MENA Countries

August 2026

CONSORTIUM FOR RED PALM WEEVIL CONTROL

R4D Brief: Socioeconomic and Environmental Impacts of the Red Palm Weevil in MENA Countries

Boubaker Dhehibi[1], Rania Soula[1], Aymen Frija[1], Mohamed Ali Bob[2], Seid Ahmed-Kemal[3], Bezaiet Dessalegn[4], Arash Nejatian[5], Hamadttu ElShafie[5], Mojeeb Stanikzai[5], Augusto Becerra[6]

Acknowledgement

This research was conducted under the Consortium for Red Palm Weevil Control Program (C4RPWC), implemented by the International Center for Agricultural Research in the Dry Areas (ICARDA), with financial support from the International Affairs Office, Presidential Court, United Arab Emirates, and the Gates Foundation.

Suggested Citation

Dhehibi, B., Soula, R., Frija, A., Bob, M.A., Ahmed-Kemal, S., Dessalegn, B., Nejatian, A., ElShafie, H., Stanikzai, M., and Becerra, A. 2026. *Socioeconomic and Environmental Impacts of the Red Palm Weevil in MENA Countries*. R4D Brief. Consortium for Red Palm Weevil Control Program (C4RPWC). ICARDA.

1International Center for Agricultural Research in the Dry Areas (ICARDA), Ariana, Tunisia (b.dhehibi@cgiar.org; r.soula@cgiar.org; a.frija@cgiar.org)

2International Center for Biosaline Agriculture (ICBA), Dubai, United Arab Emirates (m.ali@biosaline.org.ae)

3International Center for Agricultural Research in the Dry Areas (ICARDA), Rabat, Morocco (s.a.kemal@cgiar.org)

4International Center for Agricultural Research in the Dry Areas (ICARDA), Cairo, Egypt (b.dessalegn@cgiar.org)

5International Center for Agricultural Research in the Dry Areas (ICARDA), Ajman, United Arab Emirates (a.nejatian@cgiar.org; h.elshafie@cgiar.org, m.stanikzai@cgiar.org)

6International Center for Agricultural Research in the Dry Areas (ICARDA), Rabat, Morocco (a.becerra@cgiar.org)

Contents

Acronyms

C4RPWC	Consortium for Red Palm Weevil Control Program
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
ICARDA	International Center for Agricultural Research in the Dry Areas
ICBA	International Center for Biosaline Agriculture
IPM	Integrated Pest Management
MENA	Middle East and North Africa
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
R4D	Research for Development
RPW	Red Palm Weevil
UAE	United Arab Emirates
UAV	Unmanned Aerial Vehicle

Highlights

- This brief synthesizes evidence on the socioeconomic, environmental, and policy impacts of the Red Palm Weevil (RPW) across the Middle East and North Africa (MENA), highlighting its growing threat to date palm production and rural livelihoods.
- RPW causes significant economic losses through reduced yields, palm mortality, higher production costs, and trade disruptions, with smallholder farmers being the most vulnerable due to limited access to resources and pest management technologies.
- Intensive reliance on chemical control contributes to environmental degradation, biodiversity loss, and pesticide resistance, emphasizing the need for more sustainable management approaches.
- Early detection, preventive monitoring, strengthened quarantine systems, and the adoption of Integrated Pest Management (IPM) are identified as the most effective strategies for limiting RPW spread and reducing long-term impacts.
- The review concludes that sustainable RPW management requires coordinated regional action combining science-based IPM, technological innovation, stronger phytosanitary governance, farmer capacity building, and cross-country collaboration.

Background

The Red Palm Weevil (RPW) was first detected in the Middle East and North Africa (MENA) region in the United Arab Emirates and Qatar in 1985, followed by Saudi Arabia in 1987 and Tunisia in 2011, most likely through the movement of infested ornamental palms (Faleiro et al., 2012). Since then, it has become one of the most destructive pests of date palms across the MENA region owing to its concealed larval development, delayed detection, and the favorable climatic conditions that facilitate its establishment and spread. Its continued expansion threatens agricultural productivity, rural livelihoods, ecosystem services, trade, and the cultural heritage associated with oasis agriculture. Date palm cultivation is a strategic sector across the MENA region, particularly in Saudi Arabia, Egypt, Algeria, Tunisia, Morocco, and the United Arab Emirates, which together account for a substantial share of global date production. Beyond its economic value, the sector plays a vital role in food security, employment, export earnings, and the sustainability of arid agroecosystems. The larvae develop within the palm trunk, causing extensive internal damage that often remains unnoticed until infestations reach an advanced stage. Consequently, affected palms often suffer irreversible decline and eventual death. The pest spreads primarily through the movement of infested planting material and ornamental palms, while inadequate surveillance and weak quarantine systems facilitate its continued expansion across the region. This study synthesizes the regional literature on the socioeconomic and environmental impacts of RPW in the MENA region and identifies policy priorities for strengthening IPM and enhancing regional cooperation for its control.

Conceptual Framework

The conceptual framework developed in this review illustrates the linkages between RPW infestation, socioeconomic impacts, environmental pressures, and policy responses. It shows how infestations influence agricultural productivity, livelihoods, trade, ecosystem services, and

community resilience, while highlighting the importance of surveillance systems and IPM strategies in reducing these effects. The framework also underscores the need for coordinated regional action and stronger institutional collaboration to support sustainable RPW management (Figure 1).

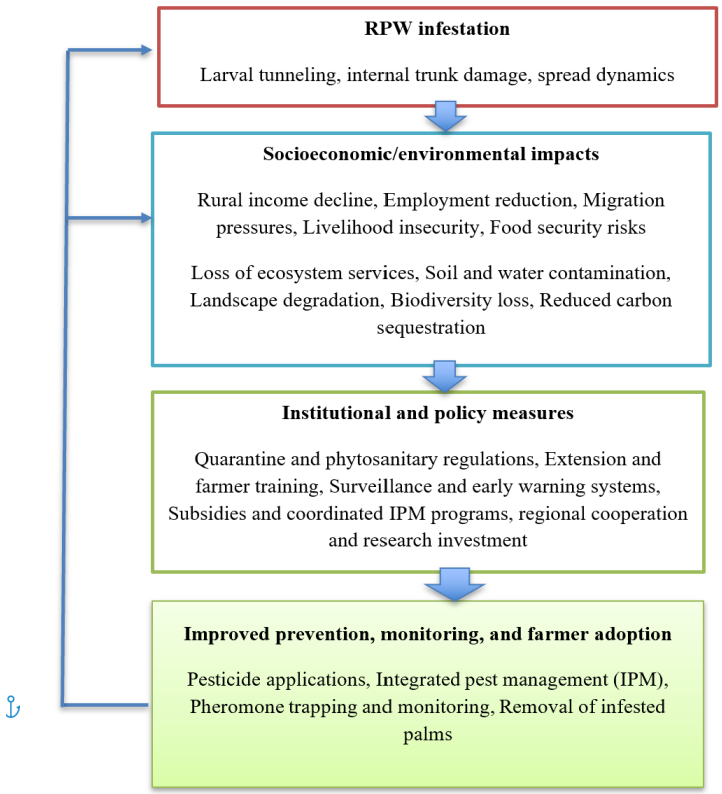

Figure 1. Conceptual Framework Linking RPW Infestation, Socioeconomic and Environmental Impacts, and Institutional Responses in MENA Date Palm Systems

Methodology

This study is based on a systematic literature review of scientific articles, institutional reports, and technical publications on RPW management in the MENA region published between 2000 and 2025. Study selection followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a transparent and reproducible process for identification, screening, eligibility assessment, and inclusion (Page et al., 2021). The analysis assesses RPW-related challenges and responses across the MENA region. It synthesizes evidence on production losses, economic and trade impacts, farmer livelihoods and adaptive capacity, environmental effects, labor and social implications, and institutional responses, while also identifying key knowledge gaps and strategic priorities for strengthening sustainable and integrated RPW management across MENA countries.

Key Economic Impacts

RPW is one of the most destructive pests affecting date palm production across the MENA region, causing substantial economic losses, declining farm profitability, and increasing pressure on rural livelihoods. Because larvae feed inside the palm trunk, infestations often remain undetected until severe internal damage has occurred, resulting in significant yield losses and palm mortality. Under poor orchard management, production losses may reach 30 to 40%, while infestation rates of only 1 to 5% can generate considerable economic losses through reduced productivity, palm removal, replacement, and increased expenditures on surveillance, pesticides, and control measures (Ben Salah, 2019).

The economic burden extends from individual farms to national economies. For example, in Saudi Arabia, RPW affects approximately 123,000 smallholder date palm farms, with annual production losses estimated at US$6 to 17 million (Ghanem et al., 2020). Across the Gulf region, annual losses associated with destroyed palms are estimated at US$1.7 to 8.69 million, while palm removal costs range from US$5 to 25 million, depending on infestation levels (Balijepalli & Faleiro, 2019). In Egypt, more than 70,000 palms were destroyed, over 250,000 palms became infested, annual control operations exceeded US$2.9 million, and cumulative economic losses reached approximately US$85 million between 1993 and 2000 (Abbas, 2021). These estimates likely underestimate the true economic burden because they exclude ecosystem services, cultural values, and income losses during the lengthy replacement period required for newly planted palms to reach full productivity.

RPW also increases production costs by requiring continuous investment in monitoring, pheromone trapping, pesticide applications, and palm removal. Although IPM improves productivity and profitability, adoption remains constrained by high initial costs and limited access to technical and financial support. In Al Ahsa, Saudi Arabia, farmers adopting IPM incurred operating costs that were 54% higher than those of non-adopters but achieved 15.3% higher income per palm (US$26.7 compared with US$23.2), demonstrating that preventive management delivers long-term economic benefits (Aldakhil et al., 2025a).

Trade, Livelihood, and Social Effects

RPW threatens domestic and international trade by reducing production volumes and increasing phytosanitary risks. Lower production limits exportable surpluses, while stricter inspection, certification, and quarantine requirements increase compliance costs and reduce market competitiveness. Countries with export-oriented date sectors are particularly vulnerable because production losses translate directly into lower export earnings and foreign exchange revenues.

The degree of vulnerability differs across major producing countries. In 2024, the United Arab Emirates exported 201,587 metric tons, representing 60.4% of national production, while Tunisia exported 130,705 metric tons, equivalent to 32.6%, and Saudi Arabia exported 351,434 metric tons, representing 18.3% of production. By contrast, Egypt, despite producing approximately 1.75 million metric tons, exported only 86,244 metric tons, or 4.9% of production, because most dates are consumed domestically (FAOSTAT, 2026). These figures

indicate that countries with greater export dependence are more exposed to RPW-related production losses and market disruptions.

Date palms also underpin rural livelihoods, food security, and employment across oasis communities. They provide household income, support processing and marketing industries, and contribute to livelihood diversification through intercropping and the use of palm by-products. RPW reduces these benefits by lowering productivity, increasing production costs, and destroying productive palms. Smallholder farmers are particularly vulnerable because limited access to credit, extension services, technical knowledge, and skilled labor restricts their ability to adopt effective pest management practices. The loss of productive orchards also weakens traditional knowledge, increases psychological stress, and contributes to rural migration, thereby reducing community capacity to implement coordinated pest management.

Environmental and Ecosystem Impacts

Date palm production systems provide essential ecosystem services that support both agricultural productivity and environmental sustainability. Healthy palm groves regulate local microclimates, stabilize soils, sequester carbon, conserve biodiversity, and provide shade that supports intercropping and diversified farming systems. RPW infestation reduces these ecosystem services through palm mortality, declining orchard productivity, and the removal of infested trees. Current control strategies also impose environmental costs. Intensive use of insecticides, trunk injections, and fumigation can contaminate soil and water resources while harming pollinators, natural enemies, and beneficial soil organisms that contribute to natural pest regulation (Abdel Banat, 2025). Although biological control methods offer more environmentally sustainable alternatives, their large-scale effectiveness remains inconsistent under field conditions. Long-term ecosystem resilience is further threatened by the widespread replacement of traditional cultivars with a limited number of commercial or tissue culture varieties following RPW outbreaks. This process accelerates genetic erosion, reduces biodiversity, and weakens the capacity of date palm populations to adapt to future pest outbreaks and climate variability. Sustainable RPW management should therefore integrate effective pest control with biodiversity conservation, reduced reliance on chemical pesticides, and the protection of indigenous date palm genetic resources.

Policy Implications

Traditional reliance on insecticides has become increasingly limited by resistance development, environmental concerns, and high costs. Consequently, IPM, combining preventive, cultural, biological, chemical, and technological approaches, has become the preferred framework for sustainable RPW management (Al Dosary et al., 2016).

Preventive and cultural measures remain the most cost-effective approaches for reducing RPW spread. These include regular field inspection, pheromone-based monitoring, sanitation, proper pruning and offshoot management, wound treatment, and improved irrigation practices such as drip irrigation to reduce favorable conditions for pest development (Nejatian et al., 2025). However, their success depends strongly on farmer awareness, willingness, and capacity to adopt recommended practices.

Early detection is critical because infestations are often identified only after severe internal damage occurs. Field inspections remain essential, while complementary technologies such as acoustic sensors, thermal imaging, IoT-based pheromone traps, remote sensing, and artificial intelligence are increasingly being developed to improve surveillance and prediction. Nevertheless, adoption of these technologies remains constrained by high costs, limited technical expertise, and inadequate digital infrastructure (Alsadik et al., 2024).

Legislative and quarantine measures are essential for limiting RPW movement through infested planting material. Effective management requires strict phytosanitary regulations, nursery certification, traceability systems, movement restrictions, and coordinated surveillance programs. Weak enforcement, illegal movement of palms, and limited availability of certified planting material remain major barriers to successful control across the region (Al-Dobai, 2019).

At the farm level, mechanical, chemical, and curative measures are commonly applied to suppress established infestations. Mechanical practices include removal and destruction of infested palms, sanitation, and wound protection. Chemical control, particularly trunk injection with systemic insecticides such as imidacloprid and emamectin benzoate, remains widely used due to its rapid effectiveness. However, repeated insecticide use increases risks of resistance, environmental contamination, and production costs, highlighting the need for integration within broader IPM programs (Alaufi et al., 2026).

Overall, successful RPW management in the MENA region depends on coordinated implementation of regulatory measures, farmer adoption of preventive practices, improved monitoring systems, and integration of emerging technologies within area-wide IPM strategies.

Key Challenges and Research Gaps

The socioeconomic impacts of RPW in MENA countries remain insufficiently quantified due to fragmented data, inconsistent methodologies, and limited integration of biological, economic, and social dimensions. Current assessments largely focus on direct losses, control costs, and palm removal, while underestimating indirect impacts such as market disruptions, quarantine costs, labor requirements, yield reductions, and long-term effects on rural livelihoods. Major knowledge gaps persist in understanding social consequences, farmer behavior, institutional factors, and adoption barriers related to IPM. Evidence is also geographically uneven, with greater availability of studies from countries such as Saudi Arabia and Egypt compared with data-limited and vulnerable contexts including Yemen, Libya, Iraq, and Sudan. Furthermore, climate change is expected to intensify RPW risks by increasing pest development, expanding distribution, and reducing date palm resilience, yet climate projections remain poorly integrated into socioeconomic and bioeconomic models. The absence of harmonized indicators, standardized monitoring systems, and integrated frameworks limits accurate regional assessment and effective long-term planning.

Conclusion

The RPW remains one of the most significant threats to date palm production, rural livelihoods, and agricultural sustainability across the MENA region. Effective long-term management

requires an integrated approach that combines prevention, early detection, sustainable IPM, strengthened phytosanitary measures, and regional cooperation.

Future efforts should prioritize the development of a regional bioeconomic management framework that integrates pest dynamics with economic, social, and climate-related factors to support evidence-based decision-making. Strengthening surveillance systems, improving data sharing, expanding research in underrepresented countries, and enhancing farmer capacity through extension services and access to affordable technologies are essential. Reinforcing quarantine regulations, certified planting material, and coordinated institutional action will further reduce the spread of RPW. Together, these measures can improve the resilience of date palm production systems, minimize economic losses, and promote sustainable management of RPW across the MENA region.

Disclaimer

The findings and conclusions presented in this publication are those of the authors and do not necessarily reflect the views of ICARDA, the International Affairs Office, Presidential Court, United Arab Emirates, or the Gates Foundation.

References

Abbas, M. K. (2021). *The current status of Red Palm Weevil in Egypt and methods of its control*. Arab Organization for Agricultural Development (AOAD) / AARINENA.

Alaufi, M., Al Ruheili, A., Al-Wardy, M. M., & Al-Kindi, K. M. (2026). Comprehensive review of the red palm weevil: Invasion biology, distribution and management strategies. *Plant Science Today*, *13*(1), 1–14. https://doi.org/10.14719/pst.10465

Al-Dobai, S. (2019). Policies to control Red Palm Weevil based on the recommendations of the Rome meeting. *Arab Journal of Plant Protection*, *37*(2).

Aldakhil, A. I., Alamri, Y., Alsultan, M., Alduwais, A., Bashir, K., & Alhashim, J. (2025a). Evaluating the economic impact of integrated pest management (IPM) on smallholder date palms farmers. *Journal of the Saudi Society of Agricultural Sciences*, *24*, 31. https://doi.org/10.1007/s44447-025-00035-6

Al Dosary, N. M., Al-Dobai, S., & Faleiro, J. R. (2016). Review on the management of Red Palm Weevil (*Rhynchophorus ferrugineus* Olivier) in date palm (*Phoenix dactylifera* L.). *Emirates Journal of Food and Agriculture*, *28*(1), 34–44. https://doi.org/10.9755/ejfa.2015-10-897

Alsadik, B., Ellsäßer, F. J., Awawdeh, M., Al-Rawabdeh, A., Almahasneh, L., Oude Elberink, S., Abuhamoor, D., & Al Asmar, Y. (2024). Remote sensing technologies using UAVs for pest and disease monitoring: A review centered on date palm trees. *Remote Sensing*, *16*(23), 4371. https://doi.org/10.3390/rs16234371

Balijepalli, S. B., & Faleiro, J. R. (2019). Is policy paralysis on quarantine issues in the Near East and North Africa region leading to the buildup and spread of red palm weevil, *Rhynchophorus ferrugineus*? *Arab Journal of Plant Protection*, *37*(2), 89–100. https://doi.org/10.22268/AJPP-037.2.089100

Ben Salah, M. (2019). Importance of field operations for reducing Red Palm Weevil (RPW) infestation on date palm. *Arab Journal of Plant Protection*, *37*(2), 159–162. https://doi.org/10.22268/AJPP-037.2.159162

Bracchetti, L., Cocci, P., & Palermo, F. A. (2023). Multiple aspects of the fight against the Red Palm Weevil in an urban area: Study case, San Benedetto del Tronto (Central Italy). *Insects*, *14*(6), 502. https://doi.org/10.3390/insects14060502

Faleiro, J. R., Ben Abdallah, A., El-Bellaj, M., Al Ajlan, A. M., & Oihabi, A. (2012). Threat of the Red Palm Weevil to date palm plantations in North Africa. *Arab Journal of Plant Protection*, *30*(2).

FAOSTAT. (2026). *Crops and livestock products*. https://www.fao.org/faostat/en/#data/QCL

Ghanem, A. M., Alrwis, K. N., Alnashwan, O. S., Kamara, S. A., Ahamed, S. A., & Aldawdahi, N. M. (2020). Valuing and controlling the economic losses from red palm weevils in Riyadh, Saudi Arabia. *Journal of Experimental Biology and Agricultural Sciences*, *8*(4), 394–402.

Nejatian, A., Niane, A. A., & El-Shafie, H. (2025). The influence of irrigation techniques on date palm infestation by the red palm weevil. *Outlooks on Pest Management*, *36*(5), 179–183.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Welch, V. A., & Whiting, P. (2021). PRISMA 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. *BMJ*, *372*, n160. https://doi.org/10.1136/bmj.n160

CONSORTIUM FOR RED PALM WEEVIL CONTROL

Funded by

UNITED ARAB EMIRATES PRESIDENTIAL COURT
INTERNATIONAL AFFAIRS OFFICE
الإمارات العربية المتحدة
ديوان الرئاسة
مكتب الشؤون الدولية

Gates Foundation

Program lead

ICARDA
Science for resilient livelihoods in dry areas

CGIAR

National and regional partners

ICBA
المركز الدولي للزراعة الملحية
INTERNATIONAL CENTER FOR BIOSALINE AGRICULTURE

UNITED ARAB EMIRATES MINISTRY OF CLIMATE CHANGE & ENVIRONMENT
الإمارات العربية المتحدة
وزارة التغير المناخي والبيئة

هيئة أبوظبي للزراعة والسلامة الغذائية
ABU DHABI AGRICULTURE AND FOOD SAFETY AUTHORITY

وزارة الزراعة واستصلاح الأراضي
ARC
مركز البحوث الزراعية
Agricultural Research Center

Desert Research Center
The Egyptian Ministry of Agriculture and Land Reclamation

AGERI

UM6P
University Mohammed VI Polytechnic

جامعة نيويورك ابوظبي
NYU ABU DHABI

International partners

icipe

IITA
Transforming African Agriculture

ICRISAT
INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

UCDAVIS
UNIVERSITY OF CALIFORNIA

SPECTRAL ANALYTIX

NIBIO
NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

Embrapa