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High-level meeting on the management strategy of transboundary plant pests and diseases in NENA region

21-23 June 2023 Bari, Italy

Red Palm Weevil: Damages, Spread, and the Economic Impact in NENA Countries

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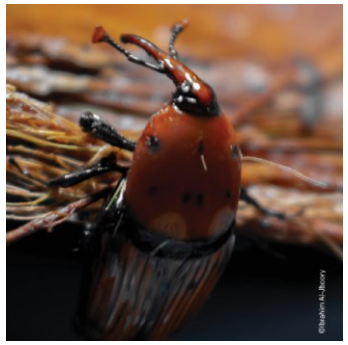
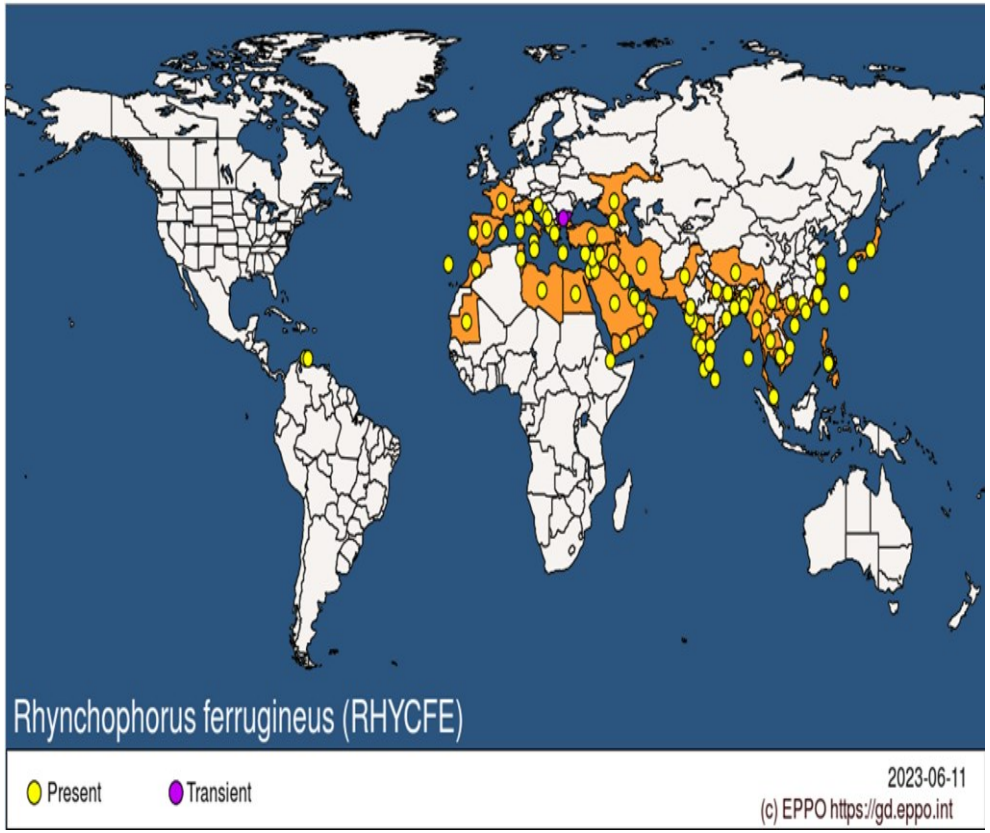



RPW- Geographical Distribution

The weevil has invaded a total of 49 countries over the last 30 years, and the host range has expanded from only four species in the mid-1950s to 40 species in 2020.

EPPO Region: Albania. Bosnia and Herzegovina. Bulgaria. Croatia. Cyprus. France (mainland. Corse). Georgia. Greece (mainland. Kriti). Israel. Italy (mainland. Sardegna. Sicilia). Jordan. Malta. Montenegro. Morocco. Portugal (mainland. Madeira). Russia (Southern Russia). Spain (mainland. Islas Baleares). Tunisia. Türkiye
Africa: Djibouti. Egypt. Libya. Mauritania. Morocco. Tunisia
Asia: Bahrain. Bangladesh. Cambodia. China (Fujian. Guangdong. Guangxi. Hainan. Jiangsu. Xianggang (Hong Kong). Xizhang. Yunnan. Zhejiang). India (Andaman and Nicobar Islands. Andhra Pradesh. Assam. Bihar. Damman. Diu. Goa. Gujarat. Karnataka. Kerala. Maharashtra. Meghalaya. Odisha. Tamil Nadu. Tripura. Uttar Pradesh. West Bengal). Iran. Iraq. Israel. Japan (Honshu. Kyushu. Ryukyu Archipelago). Jordan. Kuwait. Lebanon. Malaysia (West). Myanmar. Oman. Pakistan. Philippines. Qatar. Saudi Arabia. Sri Lanka. Syria. Taiwan. Thailand. United Arab Emirates. Vietnam. Yemen
Central America and Caribbean: Aruba. Netherlands Antilles



RPW Damage costs - Facts

- The combined cost of pest management, eradication and replacement of infested palms and loss of benefits was around €90 million by 2013 for France, Italy and Spain (FAO, 2017).
- In NENA countries, RPW causes economic losses in the millions of dollars annually, whether through lost production or pest-control costs (Almost USD 8 million is lost each year through removal of severely-infested trees alone) economic context of farmers, level of technology employed and level of enforcement of quarantine measures (Alotaibi et al, 2022).
- RPW damage affects the income of around 123.000 small farms in Saudi Arabia. Annual losses in date production range between USD 6 and 17 million and the cost of removal of infested palms in the Gulf region is estimated to be between USD 5 and 25 million at an infestation rate of 1% and 5% palm tree, respectively. These losses reduce the contribution of the date palm sector to Saudi Arabia's GDP (Ali-Bob, Mohammed, 2019).
- The estimated costs of curative control of date palms in the early stage of infestation are USD 103.7 million at a 5% infestation level (Sarwar, 2016).

RPW Damage costs - Facts

- In most European countries, the target of red palm weevil infestation is mainly the ornamental palms ruining the aesthetic beauty of parks and roads.
- Overall, red palm weevil damage to any type of palm accounts for losses of millions of dollars because the pest feeds on the trunk.
- To estimate baseline economic impacts over a ten-year period to 2023, a bioeconomic model integrating the spread and impact was developed assuming that current EU emergency phytosanitary measures, designed to inhibit spread were fully implemented across member states affected by the pest infestations.
- The model projected impacts of over €146 million in Spain, €73 million in Italy, €60 million in Greece and €35 million in France in 2023 (EU, 2015).
- The two largest components of costs were

  (i) replacement values for felled trees, and

  (ii) inspection costs

Economic impacts of RPW: Why?

- Despite these conceptual challenges, economic assessments of the impacts of RPW are needed to provide credible information to policy makers and to justify costs associated with management efforts.
- RPW is one of the world's major invasive pest species and is the single most destructive pest of some 40 palm species worldwide.
- Cost of pest management, eradication and replacement of infested palms, and loss of benefits are remarkable.
- Continuous challenges facing the successful management and containment of the spread of RPW (i.e., NENA countries and worldwide).
- The assessment of socio-economic and environmental impacts of control and eradication interventions should be at all levels of control and prevention.
- This assessment should be conducted through application of rigorous assessment methods to estimate the impact of RPW control or eradication and the associated costs and benefits for different farming systems and farm sizes.

FAO-AOAD-ICARDA-CIHEAM-Bari Project

Socio-Economic Impact of the Red Palm Weevil in NENA Countries

Collaborative Research Outcome

Research objectives

- Characterize the existing state of the Red Palm Weevil (RPW) spread and control in Egypt and Saudi Arabia.
- Elucidate the perceptions of farmers in dates production and protection of RPW spread as well as efforts to contain it.
- Assess the perception risk and governance effectiveness indicators of RPW.
- Quantify the socio-economic impacts of the RPW spread and identify the main intervention measures in Egypt and Saudi Arabia.
- Evaluate farmers' adoption of RPW IPM practices and examine the differences in adoption according to the farmers' socio-economic attributes and their farm characteristics.

Methodological framework

Data collection, Sampling design, and Selection of the respondents

- Sampling design and date collection established by the Arab Organization for Agricultural development (AOAD) team:
- The sampling frame was based on:
  - The territorial distribution of date palms within each one of the two selected countries (i.e., KSA and Egypt).
  - The associated incidence of RPW infestation (i.e., Governorate Selection/country) and on the variations in farming systems.

Methodological framework

Data collection, Sampling design, and Selection of the respondents:

The ex-post impact assessment study considered a total of 840 respondents identified during the ex-ante impact assessment study process (with 360 respondents in Egypt and 480 respondents in Saudi Arabia).

Egypt : 360 respondents	Lower Egypt (Ash Sharqiyah Governorate) (120 HH)
	Upper Egypt (Aswan Governorate) (120 HH)
	Oases (Al Wahat Al Bahriyah) (120 HH)
Saudi Arabia : 480 respondents	Riyadh (120 HH)
	Qassim (120 HH)
	Al Ahsa (120 HH)
	Al Madinah (120 HH)

The sample was randomly selected from each one of the selected Governorates.

Methodological framework

Data collection, Sampling design, and Selection of the respondents:

- Traditional (Scattered) are irregularly spaced date palm farming systems based on flood irrigation.
- Traditional (Organized) are well-spaced date palm farming systems based on flood irrigation.
- Modernized are date palm farming systems based on localized irrigation (drip, bubblers, etc.).

Types of Farming System		
Traditional (Scattered)	Traditional (Organized)	Modernized

Methodological framework

Quantitative Economic Assessment Techniques

In the literature, three techniques for quantitative economic assessment: Partial budgeting, partial equilibrium analysis and computable general equilibrium analysis:

Partial budgeting

- Is a method that addresses the additional costs and lost revenues that are incurred at the producer level when the RPW invades.
- This method considers the area attacked by the RPW, the loss per unit area, and the price of the product.
- It does not include relationships between production volume and prices, or interlinkages between markets.
- Is the easiest and fastest to conduct.

Partial equilibrium analysis

- Consider the price effects of changes in production volume in addition to those factors already taken into account by partial budgeting.

Methodological framework

Partial Budget Analysis (PBA)

The need for the use of analytical techniques other than PBA is precluded since the RPW infestation in the targeted countries does not affect the quality of dates nor cause reduction in production to the extent that significantly influences market forces and prices (producers' interviews), and henceforth warrants the use of other analytical techniques that could capture these market changes, such as partial and general equilibrium analysis.

The PBA technique evaluates the economic consequences of an adjustment/ change that impacts farm organization through direct changes to cost and revenue streams:

Partial Budget Analysis (PBA)	
A) Additional costs incurred Costs under the RPW Spread and Treatment that are not required under the Control situation	E) Costs foregone Costs under the Control situation that will be avoided under the RPW Spread and Treatment
B) Revenue foregone Returns under the Control situation that will not be received under the RPW Spread and Treatment	D) Additional Revenue generated Returns under the RPW Spread and Treatment that are not received under the Control situation
Total Costs: C =A+B	Total Benefits: B =E+D
Net Change: (B – C)	

Methodological framework

Elaboration of Specific Indices to Risk & Governance (Elaborated by CIHEAM Bari experts)

- Conceptual framework: based on FAO Sustainability Assessment of Food and Agriculture Systems (SAFA) tool, particularly the dimension of sustainability "Good governance" at the farm level. The concept proposed here is a structured system of indices that ranks and score the concerned countries and governorates according to their likelihood and suitability for RPW establishment and spread.
- We divide the assessment of the concerned farms into two macro areas: (i) Perception risk (P) and (ii) Governance effectiveness (G) towards RPW invasion.

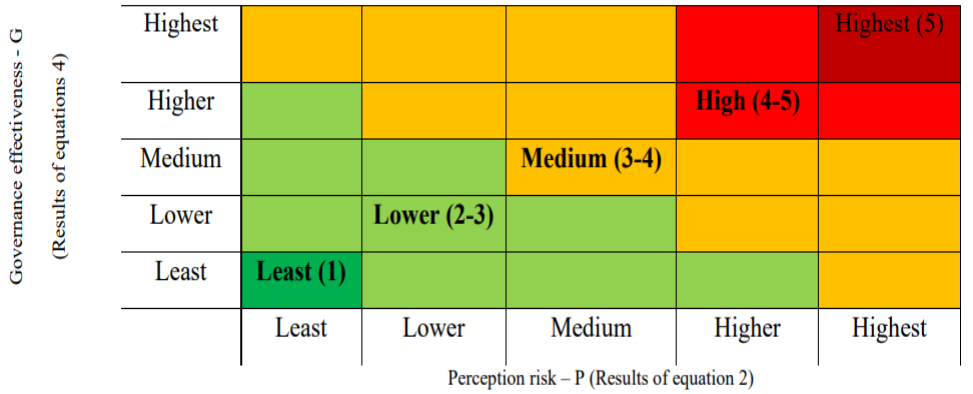
Perception risk (overall index P):

- ✓ Socioeconomic index (partial index P1)
- ✓ Information & Communication index (P2)
- ✓ Inspection perception index (P3)
- ✓ Training index (P4)
- ✓ Technical management index (P5)

Governance effectiveness (overall index G):

- ✓ Public support index (partial index G6)

Method for combining the levels of perception and governance effectiveness risk indices to form an overall assessment of vulnerability to RPW invasion. The diagram assembles five relative rank categories at each macro area considered in our assessment model.



Key findings

Intensity and Scale of RPW Infestation

Region/Governorate	Rate of RPW Infestation (%)
Lower Egypt (Ash Sharqiyah)	5.94
Oases (Al Wahat al Bahriya)	7.26
Upper Egypt (Aswan)	7.95
Canal and Red Sea	6.27
National Average	6.98

Source : MALR - 2021

Region	Rate of RPW Infestation (%) 2021-2022
Al Ahsa	0.92
Al Madinah	2.72
Qassim	3.34
Riyadh	1.90
Country Average	2.22

Source : AOAD/MEWA Field Surveys 2022

Key findings

Types of Control Methods

Prevention Methods
Checking trees regularly to detect early infestation
Removing offshoots as a protective measure
Pruning and removing fonds in the winter
Using pheromone traps to detect early infestation
Treating lesions resulted from pruning and offshoot detachment by using contact pesticides
Legislative Methods
Not transferring infested trees or offshoots to non-infested areas
Burning and burying infested palm far away after cutting it into small portions
Not transferring infested palm waste to other areas
Surveying RPW-infested palms and inform authorities when necessary
Not allowing anyone to transfer infested offshoots from an infested farm
Cultural Methods
Adhering to the time and depth specified for planting offshoots
Applying moderate irrigation to reduce humidity on farms
Adhering to good plowing before planting
Maintaining the recommended distance between trees

Key findings

Types of Control Methods

Mechanical Methods
Covering roots of small trees with soil to a height of 20 cm to prevent insect attacks
Removing weeds and dry trunks and disposing of them in the recommended way
Eradicating infested palms
Removing infested or dead trees and the pruning products on neglected farms
Closing all openings on the trunks of palms
Scraping infested areas until healthy tissue is exposed

Chemical Methods
Spraying according to extension recommendations
Spraying pesticides of proper quantity and quality and within the specified time frame
Dusting farms

Control Methods of RPW in Egypt

Severity of Infestation	Location	Treatment
Low	Offshoots	Dipping with solution of pesticides Manual clearance of the whole place of infestation and covering the pit with mud pasted sometimes with cement. In few cases chemicals are also sprayed in the pit manually or forced through a motor pump
	Trunk	Injection of chemicals through holes drilled. manually or mechanically, into the trunk. This is the most widely spread technique in Egypt
	Top/Head	Dipping with solution of pesticides
Medium	Trunk	Injection of chemicals through holes drilled manually or mechanically Manual clearance of the whole place of infestation and covering the pit with mud pasted sometimes with cement. In few cases chemicals are also sprayed in the pit manually or forced through a motor pump
High	Trunk	Injection of chemicals through holes drilled, manually or mechanically, into the trunk Manual clearance of the whole place of infestation and covering the pit with mud pasted sometimes with cement. Fumigation (used at a limited scale in Egypt)

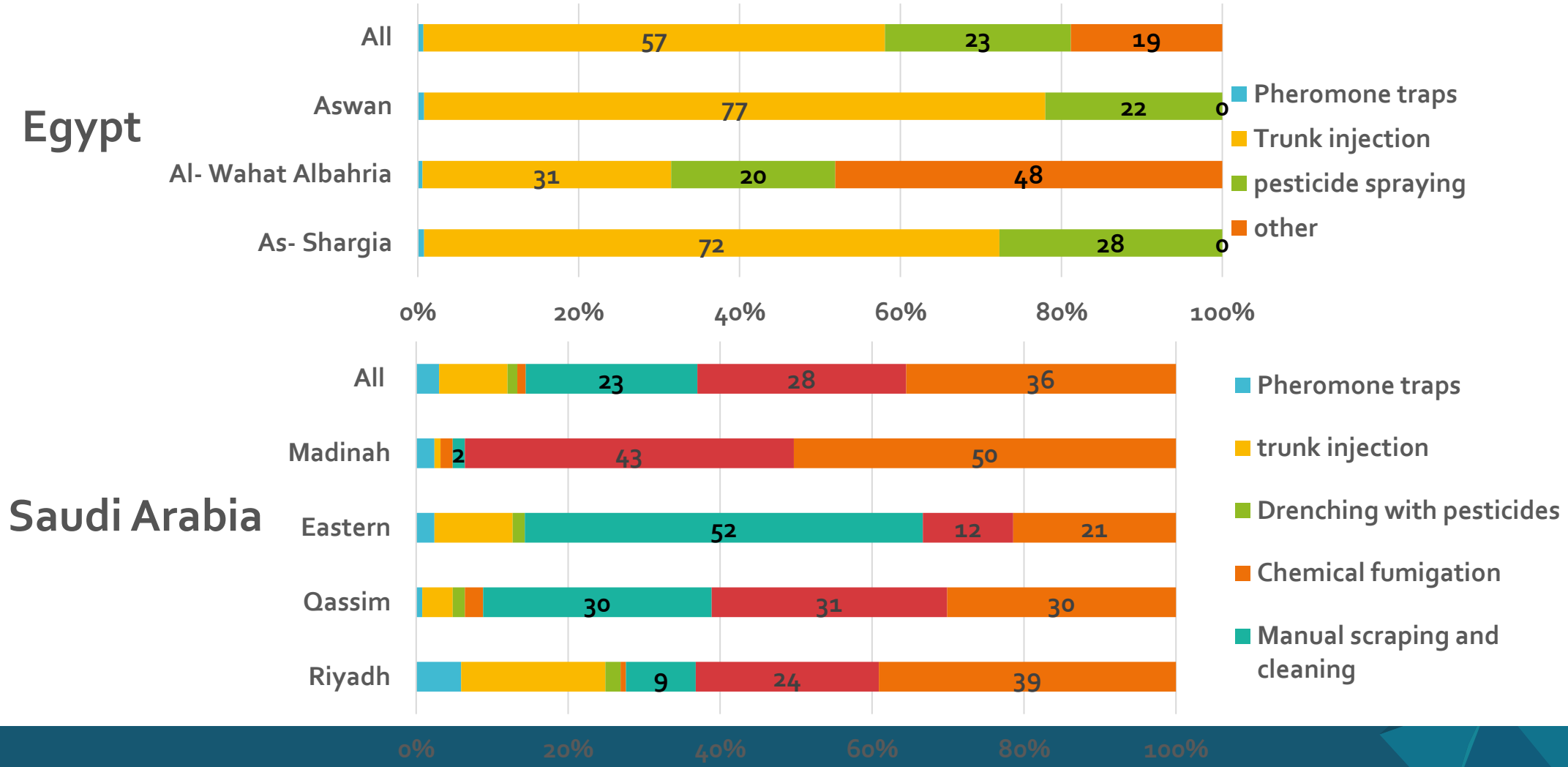
Key findings

Recommended Preventive Measures in Saudi Arabia

- Regular inspection for early detection
- Separation of off-shoot
- Treatment with contact pesticides of wounds and lesions resulting from pruning and separation of off-shoots
- Prevention of moving infested date palm trees or off-shoots to non- infested areas
- Prevent transferring infected palm waste to other areas
- Separation of off-shoot
- Chopping/shredding of felling Date palms into small pieces and burning and burying the debris
- Survey of palm trees infested with RPW and inform the authorities, when necessary

Key findings

Farmers Preference of Methods of Control RPW, % (Source : AOAD, 2022)

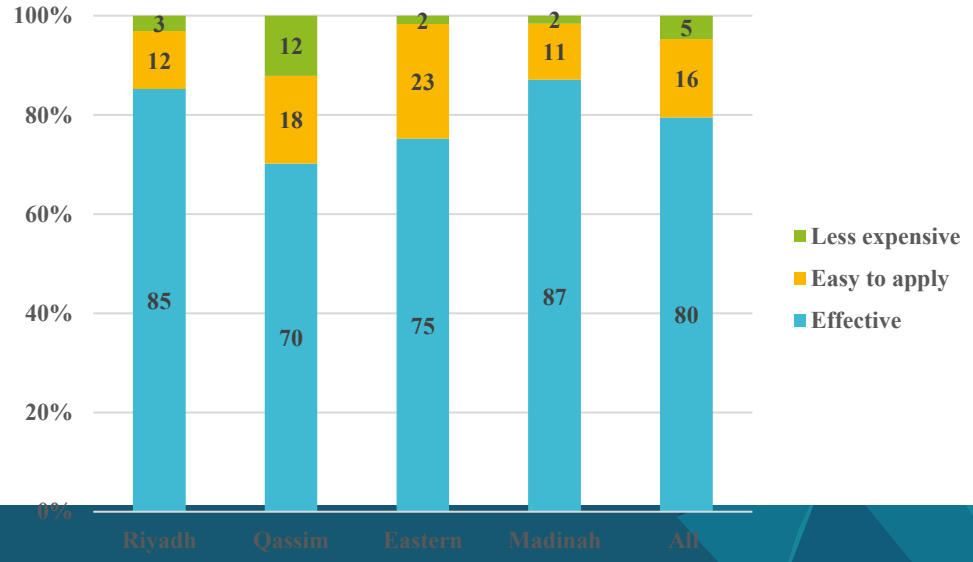


Key findings

Assessment of RPW Control Methods by Farmers, % (Source: AOAD, 2022)

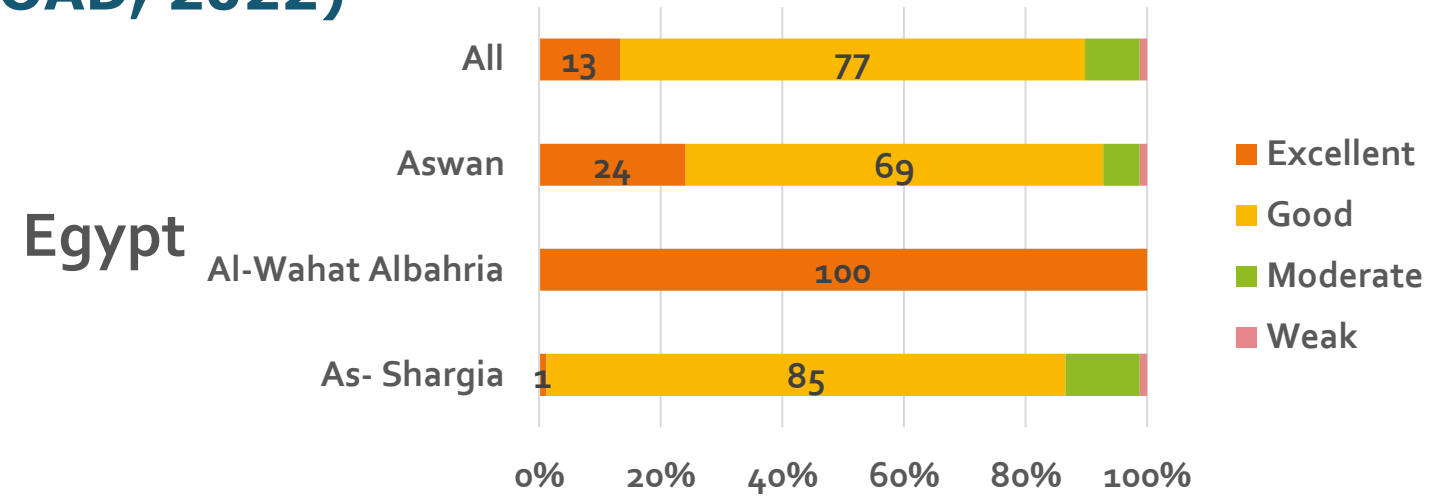
Egypt

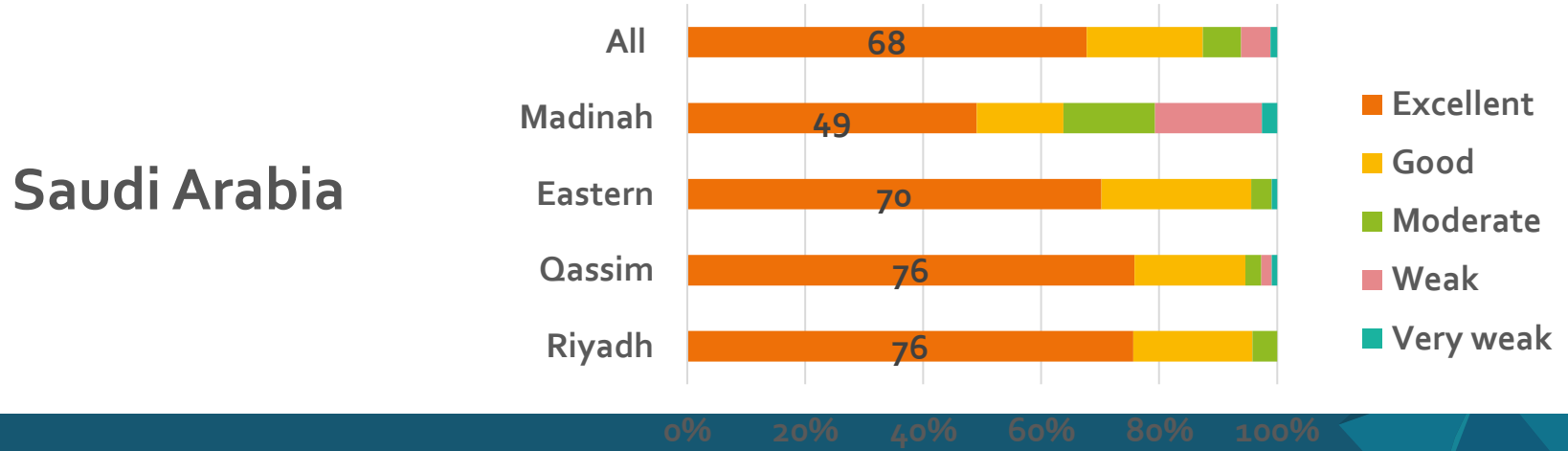
Saudi Arabia



Key findings

Efficiency of Detection in Identifying Palms Infected with RPW, % (Source : AOAD, 2022)

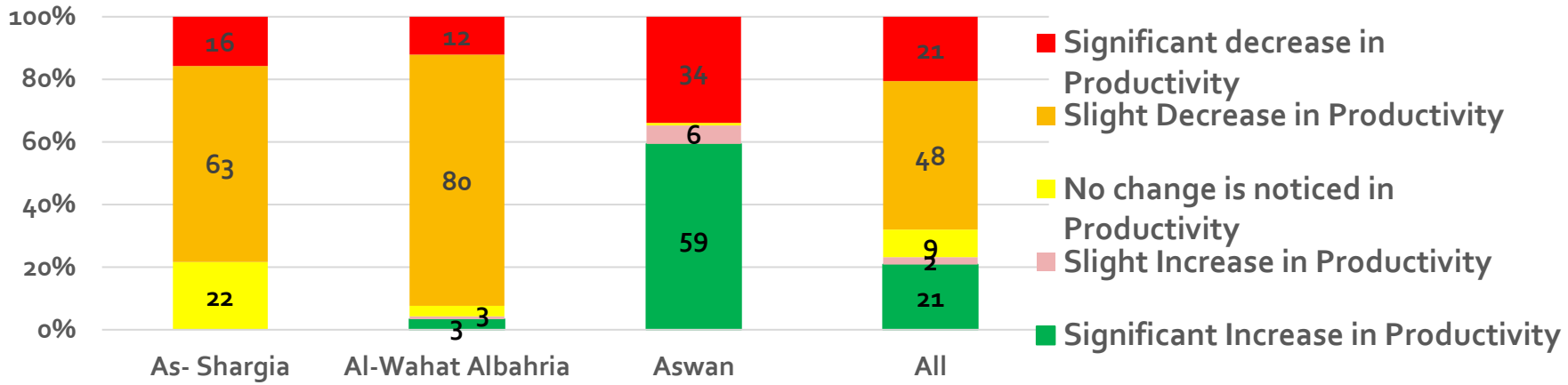




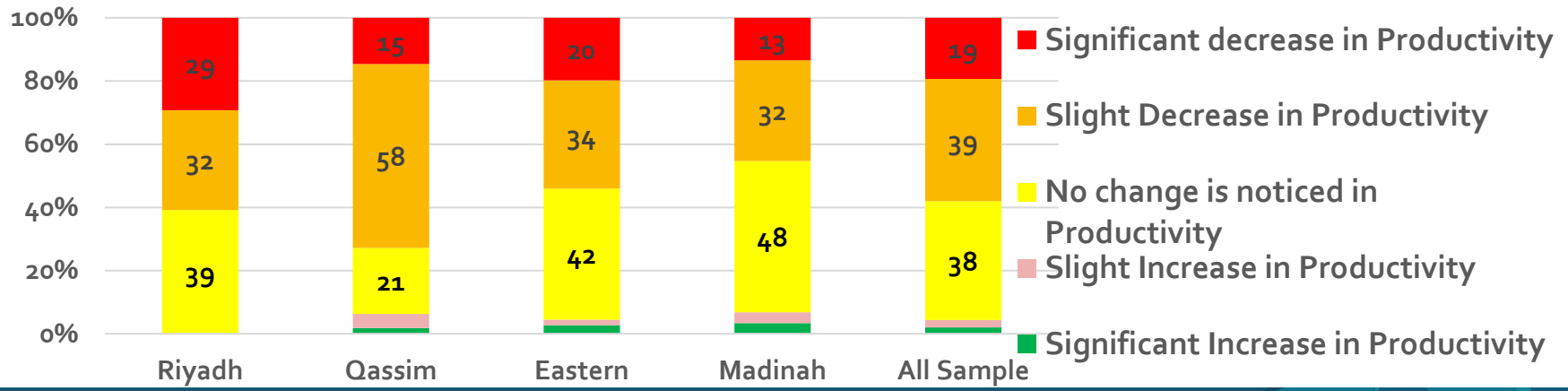
Key findings

Farmers Perception of the Impact of RPW Infestation on Tree Productivity, % (Source : AOAD, 2022)

Egypt



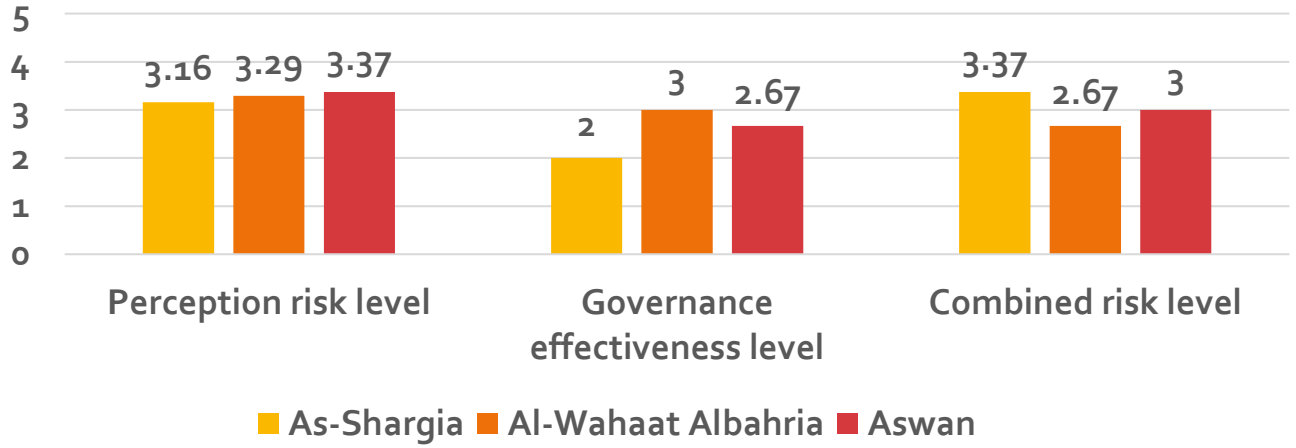
Saudi Arabia



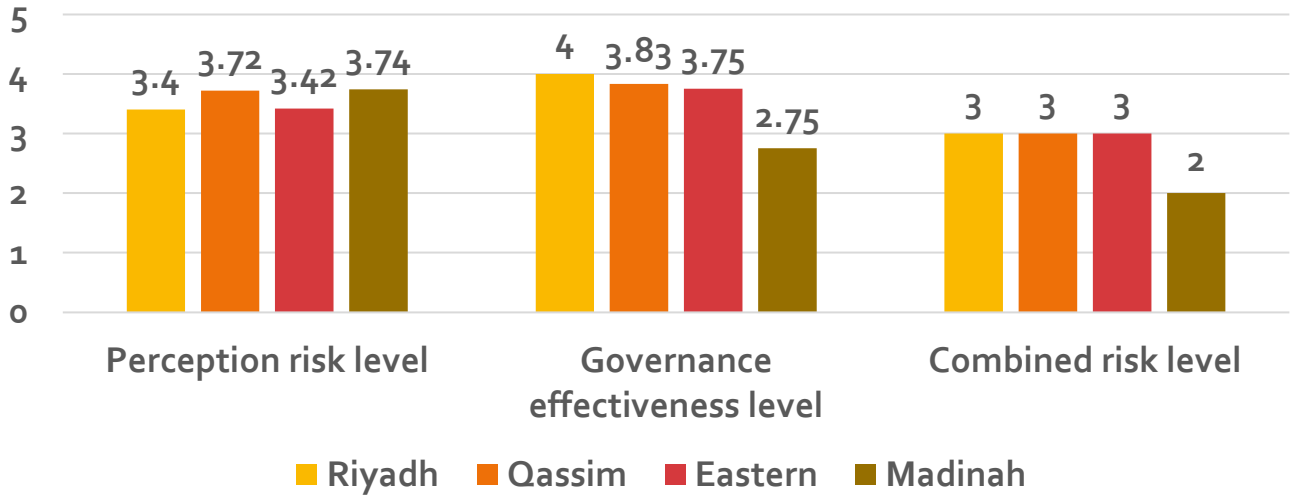
Key findings

Assessment of the Perception Risk and Governance Effectiveness Indicators (Source: CIHEAM-Bari, 2023)

Egypt



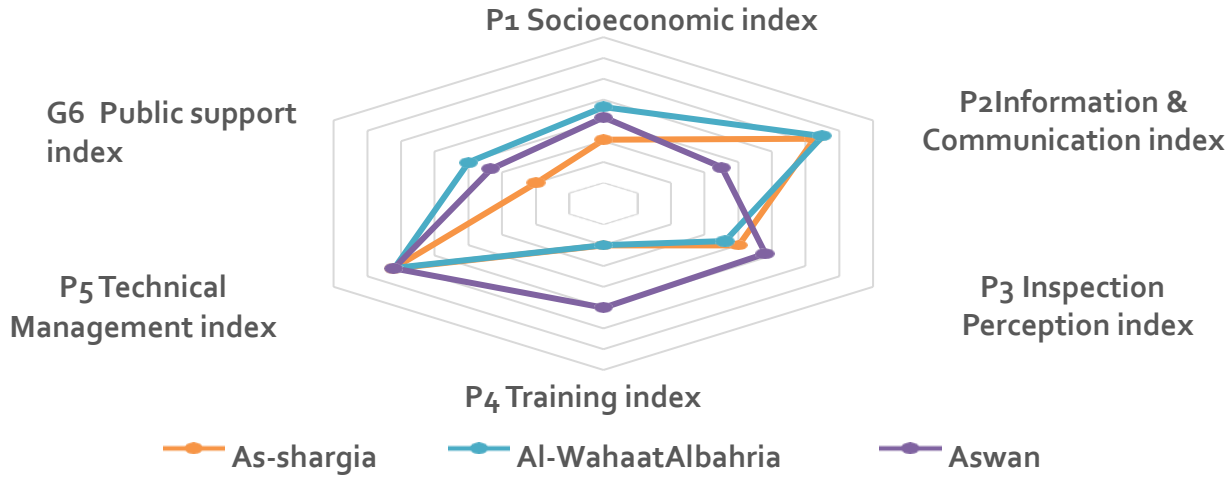
Saudi Arabia



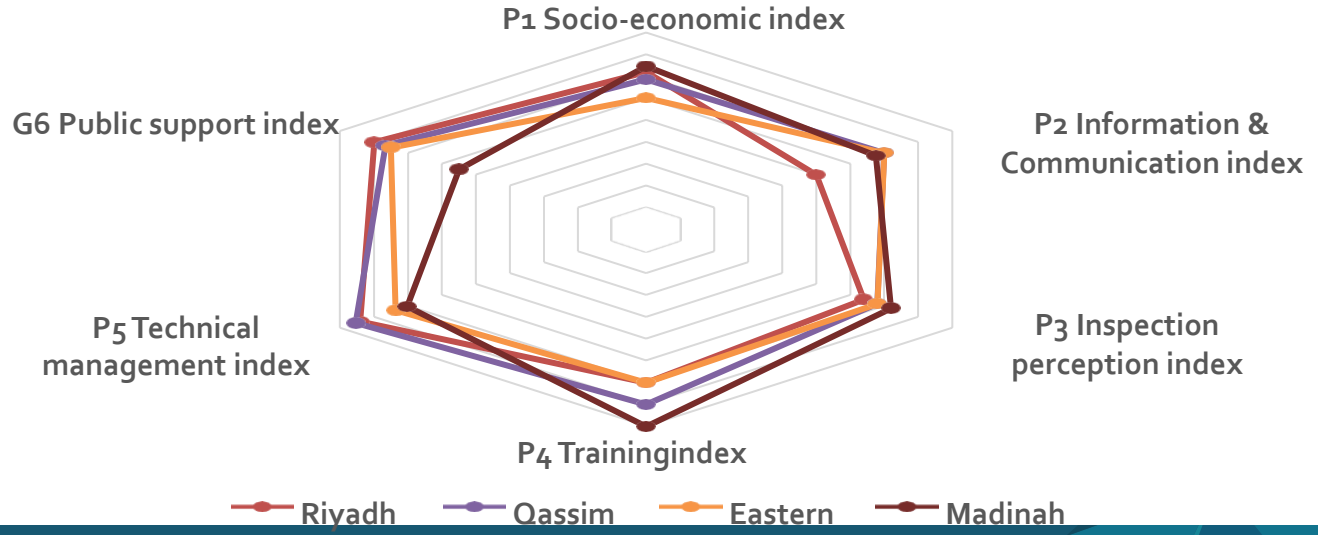
Key findings

Assessment of the Perception Risk and Governance Effectiveness Indicators (Source: CIHEAM-Bari, 2023)

Egypt



Saudi Arabia



Key findings: Cost-Benefit Results

Economics of Falling Single Date Palm by Country/Region

Egypt

Region	Debit/Cost				Benefit/Revenue			
	Revenue Foregone by loss of felling down tree	Cost of Removal of felling down tree	New Investment (Replacement Cost of removed tree)	TOTAL	Revenue from New Investment (replacement tree	Cost Foregone	TOTAL	Profit/ Loss (Loss)
As Sharqiyah	13490.42	36.67	2199.22	15726.31	7443.64	0.00	7443.64	- 8282.68
Al Wahat al Bahriya	10207.95	97.78	2089.37	12395.10	2781.52	0.00	2781.52	- 9613.58
Aswan	12978.26	21.11	1247.50	14246.87	6233.87	0.00	6233.87	- 8013.01
Average	12225.54	51.85	1845.36	14122.76	5486.34	0.00	5486.34	- 8636.42

Saudi Arabia

Region	Debit/Cost				Benefit/Revenue			
	Revenue Foregone	Removal Cost	New Investment (Replacement Cost)	TOTAL	Revenue from New Investment	Cost Foregone	TOTAL	Profit/ Loss (Loss)
Al Ahsa	7124.41	355	1443.17	8922.58	2741.04	0.00	2741.04	-6181.54
Al Madinah	13210.82	242.5	923.07	14376.39	4698.29	0	4698.29	-9678.10
Qassim	13769.13	225	1174.95	15169.09	6454.16	0	6454.16	-8714.92
Riyadh	11477.17	850	1173.71	13500.88	5012.70	0	5012.70	-8488.18
Average	11395.38	418.13	1178.73	12992.23	4726.55	0	4726.55	-8265.69

Key findings: Cost-Benefit Results

Economics of Falling Single Date Palm by Country / Region

Egypt

- The national treatment cost is borne by farmers, except for the associated extension services. which is estimated at nearly USD 5.7 million.

- The annual loss from a single tree average more than USD 549 resulting in an annual national loss of about USD 213 million in total revenue forgone from falling down trees. Upper Egypt region invests the lowest (21%) in the national treatment program, which corresponds to the persisting high level of infestation (34%) in the region.

Saudi Arabia

- The loss in revenue from falling date palms is considerable, averaging USD 2200 per single date palm. The RPW control and treatment program for the infested 613.000 date palms annually costs the Saudi national economy about USD 34 million.

- The Net Present Worth of the annual loss in investment and related foregone revenue from falling Date palms in Saudi Arabia is estimated at more than USD 400 million.

Key findings: Cluster analysis

Differences between clusters according to the adoption of IPM practices for RPW control (Egypt)

	Practices	Cluster I (n = 34.1%)		Cluster II (n = 65.9%)		Mann–Whitney U	Z	P-value
		Mean	SD	Mean	SD			
Preventive measures	P1	0.87	0.338	0.92	0.275	12.877.000	-1.432	0.152
	P2	0.57	0.497	0.62	0.487	12.866.000	-0.889	0.374
	P3	0.85	0.363	0.98	0.134	11.686.000	-4.833**	0.000
	P4	0.13	0.338	0.16	0.371	13.076.000	-.0830	0.407
	P5	0.80	0.398	0.98	0.134	11.136.000	-5.732**	0.000
Legislative control	L1	0.87	0.338	1.00	0.067	11.831.500	-5.130**	0.000
	L2	0.63	0.484	0.99	0.095	8.703.000	-9.202**	0.000
	L3	0.88	0.329	0.96	0.188	12.372.000	-3.035**	0.002
	L4	0.58	0.496	0.95	0.218	8.486.500	-8.538**	0.000
	L5	0.69	0.464	1.00	0.067	9.411.500	-8.505**	0.000
Cultural practices	C1	0.82	0.385	0.99	0.095	11.233.000	-5.903**	0.000
	C2	0.67	0.473	0.98	0.149	9.327.500	-8.084**	0.000
	C3	0.79	0.410	0.97	0.176	11.100.500	-5.401**	0.000
	C4	0.70	0.460	0.94	0.236	10.259.500	-6.075**	0.000
Mechanical control	M1	0.89	0.309	0.99	0.095	12.223.000	-4.190**	0.000
	M2	0.80	0.404	0.98	0.134	11.026.000	-5.900**	0.000
	M3	0.67	0.470	0.99	0.095	9.253.000	-8.553**	0.000
	M4	0.76	0.431	0.98	0.149	10.537.500	-6.480**	0.000
	M5	0.67	0.473	0.99	0.116	9.204.500	-8.479**	0.000
	M6	0.59	0.493	0.78	0.414	10.982.000	-3.697**	0.000
Chemical control	CH1	0.77	0.421	0.98	0.134	10.696.000	-6.387**	0.000
	CH2	0.58	0.496	0.97	0.163	8.179.000	-9.358**	0.000
	CH3	0.20	0.404	0.94	0.245	3.611.000	-13.865**	0.000

** Denotes statistical significance at the 0.01 level.

Key findings: Cluster analysis

Differences between the farmer clusters according to their socio-economic attributes and farm characteristics (Egypt)

Variable	Category	Cluster 1 (34.1%)	Cluster 2 (65.9%)	χ2	p-Value
Age	0-40	38.8	23.7	11.523	0.003
	40-60	50.4	52.6		
	>60	11.3	**23.7**		
Education	Illiterate	9.1	8.1	24.016	0.000
	Primary	13.2	13.7		
	Intermediate	29.8	**54.0**		
	Secondary	12.4	4.7		
	Univ & above	35.5	19.4		
Farming experience	< 2 years	0	0.5	38.610	0.000
	2-<10 years	25.0	4.7		
	10 - < 20	44.2	37.7		
	> 20 years	30.8	**57.1**		
Number of palm trees	<500	95.9	94.4	1.263	0.532
	500-1500	1.7	3.7		
	>1500	2.5	1.9		
Income source	Dates Farming	43.3	50.0	7.227	0.027
	Other farming activities	39.2	25.5		
	Off-farm sources	17.5	**24.5**		
Trainings RPW	Yes	26.7	**58.6**	31.525	0.000
	No	73.3	41.4		
Techniques of prevention	Trapping	0.0	0.5	66.997	0.000
	Stem injection	56.1	**73.4**		
	Spraying	41.5	7.3		
	other	2.4	18.8		

Practical implications & Strategic actions

- The risk of further spread of the Weevil in both countries is looming.
- Adequate measures are urgently required in both countries to enhance the governance of the date palm farming system and ensure the resilience of the Date palm ecosystem and mitigate the risk of further spread of the insect.
- Understanding the biology of the RPW through genomics of basic research is also essential in the future for successfully controlling and eradicating the devastating insect.
- Policy-making bodies should reform the governance of the current date palm ecosystem in both countries.
- It is also very crucial to devise a mitigation plan to deter the risk of further spread of the RPW. In this regard, sustaining the ongoing integrated RPW control strategies would be critical.
- the focus should not only be placed on innovation but also on the farming context and the demographic profiles of farmers. This information is vital for identifying farmers' typologies and developing regional programs and measures (Alotaibi et al, 2022).
- to accelerate the adoption of RPW IPM practices practices need to be addressed in conjunction with others and, therefore, holistic training programs are required (Alotaibi et al, 2022).

THANK YOU

Comments / Questions