Food and Agriculture Organization of the United Nations

CIHEAM

Framework Strategy for Eradication of Red Palm Weevil

Scientific Consultation and High-Level Meeting on Red Palm Weevil Management
Rome, 29-31 March, 2017

This Document is prepared by the RPW Expert Team with support of FAO, CIHEAM and NEPPO Technical Officers

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List of abbreviations

CIHEAM	International Centre for Advanced Mediterranean Agronomic studies
EPN	Entomo-pathogenic Nematodes
EPPO	European Plant Protection Organization
FAO	Food and Agriculture Organization
FAO-CIO	FAO-Chief Information Officer Division
GIS	Geographic Information System
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
ISPM	International Standard for Phytosanitary Measures
IPPC	International plant Protection Convention
IPM	Integrated Pest Management
KSA	Kingdom of Saudi Arabia
LIBS	Laser Induced Breakdown Spectroscopy
M&E	Monitoring and Evaluation
MoA	Ministry of Agriculture
NENA	Near East and North Africa
NGO	Non-Governmental Organization
NEPPO	Near East Plant Protection Organization
NPPO	National Plant Protection Organization
NIRS	Near Infrared Spectroscopy
PRA	Pest Risk Analysis
QGIS	Quantum Geographic Information System
RBM	Result Based Management
RFID	Radio Frequency Identification
RPW	Red Palm Weevil
RNAi	Ribonucleic acid-interference
TMS	Trapping Management System
TCP	Technical Cooperation Program
USD	United States Dollar
UAE	United Arab Emirates
UTF	Unilateral Trust Fund

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1. INTRODUCTION:

Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* (Olivier) (Coleoptera : Curculionidae) is a key pest of palms originating from South and South East Asian Countries that has significantly expanded its geographical and host range during the last three decades. In the Near East RPW is causing wide spread damage to date palm *Phoenix dactylifera* L., having both agricultural impacts on the palm production, which has negative repercussions on the livelihoods of farmers and environmental impacts. In North Africa, it is also present (except in Algeria) but for the moment only in few limited spots, only on the Canary Island palm *P. canariensis*. Even when these spots are located on the Mediterranean coast, they represent a serious threat for the Southern oasis.

RPW is a quarantine pest in the Near East and North Africa (NENA) countries, as well as in countries in Latin America, it is the object of emergency measures in the European Union, and is considered a quarantine pest that should be regulated in EPPO countries as it is considered of limited distribution (A2 pest)[1]. Weak quarantine procedures and difficulties in the early detection of RPW-infested plant materials have contributed to its rapid spread. RPW has been spreading globally and has not been effectively managed in spite of several efforts and resources provided by countries and organizations. Extensive research has also been conducted on the management of RPW.

2. RATIONALE:

Many control means based on conventional and innovative technologies are today put in place, organized into several control actions or management strategies depicted in Figure 1. However, the failure to manage RPW in most of the countries can be attributed to the lack of awareness and systematic and coordinated control actions or management strategies that involve all stakeholders, which is related to inadequate human and financial resources available to combat the pest.

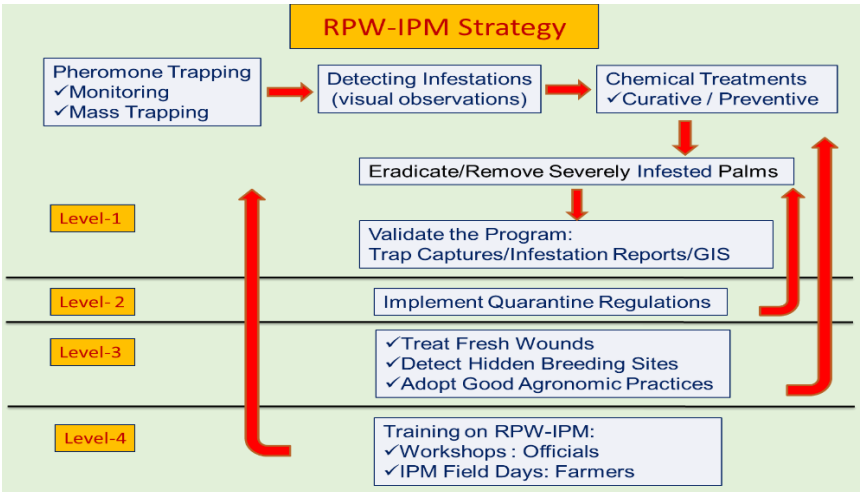

Figure 1. Major components of the red palm weevil Integrated Pest Management strategy

[1] RPW has been added to the EPPO A2 List in 2006 on the basis of a Pest Risk Analysis (PRA) performed by Spain. The full PRA and the PRA report are available at:

- https://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRAdocs_insects/04-10743%20PRA%20Rhyncho%20ferruginus.doc
  https://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRAdocs_insects/04-11057%20PRAss%20rep%20RHYCFE.doc

The strategy supported with adequate resources, with systematic planning, good coordination and involvement of all stakeholders can lead to the eradication of RPW as witnessed in the Canary Islands of Spain, where the pest is eradicated since 2013 and the last foci was declared free of RPW during May, 2016. In Mauritania, quick action initiated by the Government with support of FAO to control the pest and the IPM strategy implemented with active participation of the farmers, farmer cooperatives and other stakeholders has resulted in RPW being contained in the original foci of infestation within a year of implementing the program, with a good potential for early eradication.

The needs to control the pest are directly correlated with the evolution of the RPW populations (Fig. 2). Three scenarios are then possible depending on the means made available to control the RPW, considering of course that organizing and techniques are optimum and similar for the three scenarios:

- The means are superior to the needs (blue line). This is the wining scenario: the RPW populations will decrease irreversibly and rapidly;
- The means remain more or less equal to the needs. The populations of RPW remain more or less constant. RPW can be considered under control but each year a certain percentage of palms are lost. It is difficult to speak of a tolerance threshold in the case of the RPW because the pest not only affect the production but kills the trees. The percentage of lost palms year after year can be considered acceptable in case of big plantations but not at all for the small ones.
- The means are inferior to the needs. This is the losing scenario. Populations of RPW follow an exponential growth. Necessary means to control the pest should also grow exponentially and the gap between needs and means is rising inexorably. It is a useless and lost race.

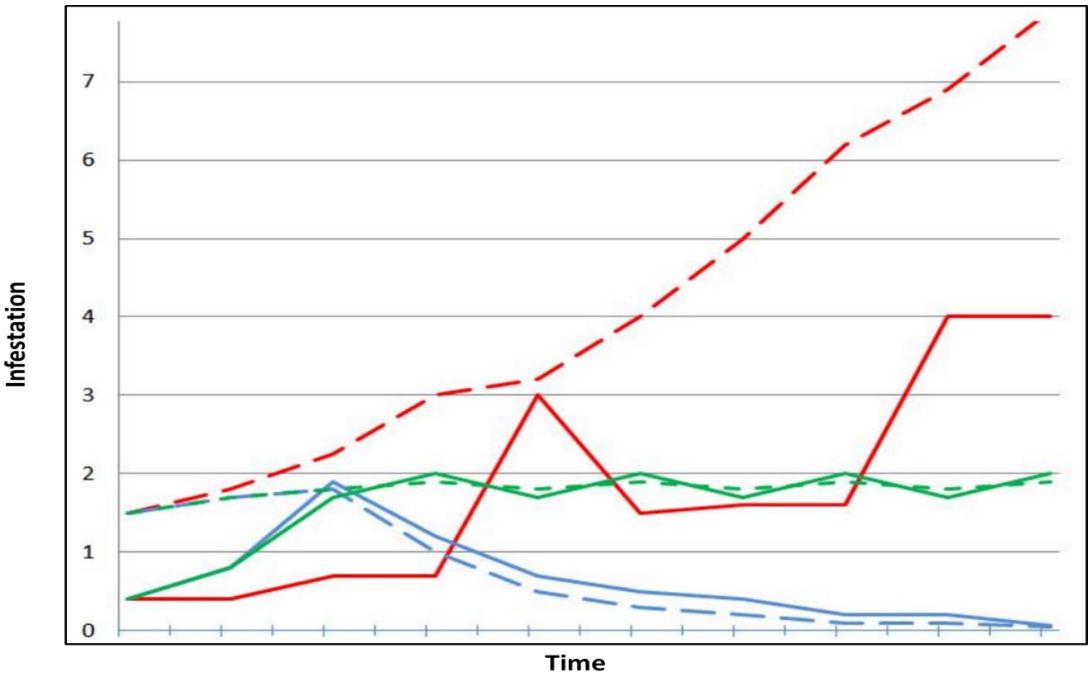

Figure 2. Three scenarios of RPW control showing the relationship between available means (solid line) and required needs (dotted line) and the results that can be expected: means are greater than the need (blue), means are equal to the need (green), means are less than the needs (red)

In addition to the above factors, there are also several biological and organizational factors hindering the success of the control strategies, such as:

Biology of the pest:

- Difficulties in early detection of infested palms due to the hidden/cryptic bionomics of the pest.
- Difficulties in implementing control treatments as the larvae life cycle takes place totally inside the palm tissue and the adults hide at the base of the leaves.

Pest management aspects:

- Late detection of infested palms because of insufficient frequency inspection activity.
- Improper assessment of the risk presented by infested palms that lead to unnecessary and costly measures of palms eradication.
- Unique morphology of the palm species that creates difficulties in implementing control practices.
- Lack of effective natural enemies under field conditions that could contribute to the reduction of the weevil population.
- Difficulties to manage a mass trapping network.
- Application of the management program in a haphazard manner.
- Difficulties in effectively managing the pest in small family gardens that represent the dominant of NENA farming system in oasis, in neglected plantations and in urban environments and in urban environments (North Africa infested spots).
- Improper transfer and disposal of severely damaged/infested palms.

Regulatory, coordination and awareness aspects:

- Illegal/unregulated movement of infested palms within the country and between countries.
- Inadequate farmer and other stakeholder involvement in the control program.
- Insufficient knowledge on the RPW socio-economic and environmental impacts and on the date palm farming systems and farmers organization.
- Unused GIS at the local and national level to have an updated knowledge of the evolution of the situation, to organize and control the activities to assess the effectiveness of the control strategy and for decision support.
- Lack of digitalized maps with the location of all the palms in the infested countries.
- Shortage of resources for implementing a comprehensive management program.
- Weak in-country cooperation and coordination between the stakeholders and also at a regional level.
- Poor implementation of phytosanitary (quarantine) measures for transfer of planting materials for new farms or gap filling in existing farm, between regions with in the country
- Inadequate protocols and certification for export /import of ornamental and exotic palms.
- Lack of public awareness on the risk associated with RPW in a broad sense.

Over the years, FAO has provided technical assistance to enhance cooperation and knowledge sharing between countries in the NENA Region, and to strengthen the capacities of the countries for the

management of RPW to reduce and prevent its spread. However, to enhance the coordination and cooperation between the countries and tackle the issue of RPW at a higher level, FAO called for a 'Scientific Consultation and High Level Meeting' to come up with framework strategy for eradication of red palm weevil . The strategy is developed based on the participatory approach involving the RPW international experts with contribution and participation of the national experts and representatives of the plant protection regulatory authorities from the affected countries and relevant organizations.

3. OBJECTIVES OF THE FRAMEWORK STRATEGY:

The overall objective of this strategy is to support efforts/programs of countries to contain the spread and eradicate the pest. The strategy will also create a framework for cooperation and coordination of efforts at the regional and inter-regional level for supporting the integrated and sustainable management programs to control RPW; and to reduce its devastating effects on the environment and food security, and socio-economic impact on rural communities.

The specific objectives are:

- To provide technical assistance and guidance for improvement of the national RPW control programs/strategies.
- To establish a platform and mechanism for strengthening the cooperation and coordination of the countries at the regional and inter-regional level for the effective management of RPW.

4. COMPONENTS OF THE PROPOSED FRAMEWORK STRATEGY:

Based on the analysis of the current management programs of RPW in different countries and identified challenges and weaknesses, the proposed strategy has two components to effectively address the problem of RPW at the country (national program) and regional (platform/program) level.

A. NATIONAL COMPONENT OF THE FRAMEWORK STRATEGY:

The national component of the framework strategy aims at improving the ongoing national programs for the effective management of RPW at country level.

In the RPW infested countries, the core components of the IPM strategy involve (i) inspecting palms to detect infestations, (ii) capturing adult weevils using food baited pheromone traps, (iii) preventive and curative chemical treatments and (iv) removal/eradication of severely infested palms. It is complemented by phytosanitary (quarantine) measures to regulate the movement of planting material, capacity building and extension activities. However, the control programs currently being implemented have by and large not been successful in containing the spread or controlling the pest despite some success stories in some countries.

The failures in the control programs can be attributed to several factors, mainly related to difficulties in detecting infested palms early in the stage of attack, challenges and constraints facing application of quarantine measures and lack of awareness and commitment of farmers and other stakeholders in the control programs.

I) Action Plan for Improved National RPW-IPM Strategy:

The proposed strategy will focus on providing the member countries with technical assistance and advice to improve the components of the RPW-IPM strategy as follows.

1. Phytosanitary (quarantine) measures

The weaknesses and constrains associated with the implementation of the phytosanitary measures can be summarized as follows:

1. Lack of knowledge on the national phytosanitary legislation on RPW.
2. Insufficient staff and means in the countries to effectively implement the regulations.
3. Illegal movement/smuggling of planting material through alternate routes.
4. Interference in the imports/movement of planting material by higher officials.
5. Lack of:
    a. Availability of sources of trustful /certified palms within the countries.
    b. Enforcement of quarantine measures.
    c. Specific regulations/guidelines on phytosanitary measures to regulate the palm trade, especially for officials / enforcement authorities at the entry points.
    d. Registered nurseries.

Specific regulations and measures (clear inspection and treatment protocols) should be developed within the phytosanitary legislation related to requirements for import as well as the movement of palms inside the countries.

Import and movement of plant material inside the country is the main pathway of introduction and spread of RPW. Prevention of the introduction of planting material, as a phytosanitary measure is the main approach that should be taken against the RPW for the countries where the pest is absent or of limited distribution.

The International Plant Protection Organization (IPPC) will play an important role in improving the phytosanitary aspects of the national RPW programs. The IPPC is the phytosanitary standard setting organization recognized by the World Trade Organization, with 183 Contracting Parties, including all NENA countries. At the NENA region, the Near East Plant Protection Organization (NEPPO) is in charge of the regional collaboration, coordination in area of plant protection and development of the regional phytosanitary standards and strategies to monitor and control the trans-boundary plant pests.

1.1. Phytosanitary import regulations/legislations

Due to the cryptic biology of RPW, importation of palms plants should be strictly regulated. The importation of date palm offshoots and ornamental palms of more than 6 cm base diameter should be banned from infested countries. Date palm from in vitro propagation should be imported in test-tubes. Acclimatization should be done at the imported country level.

However, if a country takes the risk to import date palm offshoots or ornamental palms of more than 6 cm base diameter from an infested country, import should be authorized from free-pest areas only if the limits of these areas can be established and controlled with all necessary guarantees precisely established

(50 km distance from the infested areas, traceability of all the palms in this area, absence of palms introduction for the last 3 years, no infested palms and no captures in traps for the last 3 years).

If a country accept to take the risk to import palms from free-pest areas of infested countries, importers should be registered, certified and mapped (GIS system) by National Plant Protection Organization (NPPO). They should ensure traceability and the control of the imported palms during three years. The palms should be maintained in RPW-proof quarantine facilities during one year. Inspection should be conducted by NPPO officials each two to four months.

Guidelines and procedures should be developed for strengthening quarantine inspection at borders and plant protection services within the country (including manual on identification of palms species).

1.2. Phytosanitary regulations/legislations regarding the movement of palms inside an infested country

To avoid any further potential spread of RPW, movement of palms trees should be regulated within the whole country as up-to-date, precise and controllable limits of the infested areas are not usually available. Regulations should be elaborated and implemented to assure the RPW containment.

Total ban of date palm offshoots or ornamental palms movement, except palms of less than 6 cm base diameter (from tissue culture concerning date palm) constitutes the best solution as long as the RPW is not eradicated. Nevertheless, it is not always possible to adopt such drastic measure when exists a strong demand for new palms plantations.

Movement of palms in and from free-pest area could be authorized in the same conditions as the ones proposed for importing palms. Movement of palms in and from infested area should be totally forbidden excepted if they are previously inspected, treated before transport and maintained in RPW-proof certified nurseries at least for one year. The traceability of these palms should be established during three years.

Nurseries should be registered, certified and controlled by an official institution to ensure their compliance with a certification scheme (variety authentication and free from pests including RPW).

Appropriate protocols for the palms inspection, treatments before transport to the certified nursery and for the implementation of RPW-proof certified nurseries should be developed.

In case of detection, the National Plant Protection Organization (NPPO) should delimit the infested area (at least 100 meters around the infested tree or trap that has captured a weevil), define the containment area, a buffer zone area and trace back the related plant material. These areas should be mapped and NPPO with the collaboration of the farmers, the extension agents and all concerned administrations and stakeholders should implement the appropriate measures to contain and eradicate/suppress RPW such as:

i) information of all the farmers and date palms owners in the delimited zone and adopt in collaboration with the other Ministry of Agriculture services as well as all concerned stakeholders all the measures that would facilitate the involvement of the farmers and of the palm owners in the control of the pest;
ii) frequent inspection – at least monthly - of all the palms in the infested area;

iii) implementation of a pheromone mass trapping or, at least, monitoring trapping system in the infested area;
iv) intensified survey programme in an area of at least 10 km around the infestation and to trace back the related plant material in case of a new outbreak;
v) immediate destruction or, where appropriate, treatment/mechanical sanitation of the infested palms;
vi) measures to prevent any spread of RPW during the destruction or sanitation actions by application of chemical treatments in the immediate vicinity;
vii) stop movement of nursery stock from the infested area;
viii) all these activities must be registered in a GIS and analyze weekly to control their right implementation and to assess their efficiency and the evolution of the situation.

1.3. Enhancement of the implementation of the phytosanitary legislation in countries

Enforcement of the phytosanitary regulations should be supported by:

- Training of plant quarantine staff and other law enforcement authorities.
- Development of manuals and procedures on RPW specific quarantine regulations and measures, inspection measures at borders and plant protection services within the country (including manual on identification of palms species).
- Raising awareness on RPW phytosanitary legislation and measures among all the stakeholders.
- Develop guidelines for countries to establish certified and registered nurseries that would be entitled to trade RPW free palms within the countries to avoid the illegal trade and movement of the palms.
- Support the establishment of tissue culture laboratories for the production and supply of RPW free planting material.
- Strengthen the coordination and engagement of all stakeholders (farmers/farmer cooperatives, NGOs, MoA officials, other law enforcement agencies etc.).

2. Early Detection

In absence of reliable early detection tools, visual inspection is the only available effective technique, if properly and frequently applied. Visual inspection could be improved by adopting the following.

- Develop a harmonized technical protocol/manual with illustration for visual inspection in a simple and easy to understand languages of the farmer and other support staff/stakeholders.
- Improve farmer/stakeholders involvement, especially for this activity, in the framework of the general policy and program to involve the farmers in the RPW control program.
- Enforce clean cultivation especially related to offshoot management and frond pruning to facilitate visual inspection.
- Register the inspection activity, as all the other activities for its control and analysis in the GIS of the RPW control program.

Visual inspection concerns mainly the offshoots and the trunk basis of the date palms, when on the Canary palms is focused on the crown of more than 2-3 meters high due to the fact that most infestation of this species occurs in the crown.

The pheromone traps constitute a very useful tool to complete the visual inspection and as a tool to alert on the needs to increase inspections when traps capture RPW.

To increase the overall efficiency and speed of detection, there is a need for further testing and refinement of pipeline detection technologies, to develop a quick, reliable, cost effective, and easy to handle early detection device for RPW.

Using sniffer dogs to detect RPW infested date palms is possible, because the infestation start mainly in the offshoots and the basis of the trunk up to 2 m from the ground. Dog-assisted detection could suit well also at nurseries, ports of entry and/or quarantine facilities.

Other sophisticated detection techniques are currently available with only limited/experimental use.

Acoustic systems have seen limited use because they require skilled operators. Simpler, lower-cost automated systems are being developed to increase the capability of early detection efforts. Also, field studies are being conducted to reduce interference from high wind that may induce leaf-rustling noise pulses difficult to distinguish from other insects' sounds.

Near infrared detection could allow to detect early infestation but field experimentation of sensors must be implemented, especially if the purpose is to use this technique with drones or planes. Infestation in Canary palms takes place at the canopy level where physiological disturbance could probably be easier to detect than with date palms that are usually attacked at the level of the offshoots or the trunk base.

Experimentation for the creation of a portable laser induced breakdown spectroscopy based technology must go on. Such equipment would be an interesting handy tool in the early detection of RPW on ground. Furthermore, high frequency radar and X-ray technology experiments have some promises based on preliminary experiments. Satellite imaging and seismic detection could be considered for experimenting. Experiments with proteomics strategies are also promising for the development of future kits.

3. Surveillance and Monitoring

Surveillance and monitoring is vital in making a timely decision for managing RPW, should an infested palm be detected or an adult weevil is recorded in monitoring traps. Surveillance services also help to evaluate the effectiveness of control actions and declaration of pest free area. Surveillance and monitoring is carried out through systematic visual inspection of palms and by using pheromone traps. This program could be improved by adopting the following:

3.1. *Visual inspection*:

Frequency should be:

- Non-Infested area : Quarterly
- Infested Area : Bimonthly

3.2. *Trapping*

Food baited bucket pheromone (ferrugineol) traps are widely used to capture adult RPW population that attract both male and females. These traps are very effective indicators of the presence and spatial spread of the pest if well serviced, in the absence of any equivalent and cost effective technology.

Trapping efficiency can be maintained through the following:

- At least Biweekly servicing (renewal of food bait and water).
- Trap Density
  - Non-Infested area : Need based after risk assessment
  - Infested Area : 1-2 traps / ha

- A clear protocol for the surveillance and monitoring based on the International Standard for Phytosanitary Measures (ISPM 6) should be developed, including clear time-bound survey plan, guidance for surveyors, inputs and human and financial resources needed for the program.
- Attention should be given to palm nurseries, mainly for ornamental (*P. canariensis*) for instance.
- Enhance awareness, communication and participation of the farmers/stakeholders in the monitoring program and reporting incidence of pest.
- Develop and implement a mobile application and GIS aided monitoring system for efficient mapping, data collection, analysis and management of the surveillance and monitoring program.
- Immediate deployment of an intensive control program around 10 km radius from the newly detected infested palm/trap capturing weevils based on the information campaigns, farmers and all concerned stakeholders involvement and on the core RPW-IPM components of visual inspection of every palm, trapping, preventive treatment, quick curative mechanical treatments and quick eradication of severely infested palms.

4. Preventive agronomic practices

Several agronomic practices influence the incidence and build of RPW in the field and also the efficiency of visual inspection and other treatments. In this context, the following practices need to be adopted/studied to reduce the risk of infestation and facilitate management of the pest:

i) Offshoot management: Young date palms in the susceptible age group of less than 15-20 years often have a large number of offshoots that makes visual inspection of such palms to detect infestation extremely difficult. Regular leaves/offshoots pruning and also offshoots removal constitute an indispensable practice. Preventive soaking insecticide treatment of the offshoots and the trunk immediately after these operations is required to kill and to repeal the RPW attracted by the volatiles produced by the wounds. Furthermore, removal of offshoots without treating the wound with insecticide on the mother palm often results in gravid female weevils getting attracted to these sites for egg laying, resulting in a new infestation.

ii) Frond pruning: Wounds caused on the palm after frond shaving that are not treated with a repelling insecticide to neutralize the palm volatiles emitted, could also result in infestation by attracting female weevils to such odors. In some countries it is therefore recommended to carry out frond shaving during the winter when weevil activity is low.

iii) Irrigation method adopted: Open flood irrigation particularly in plantations where the water touches the collar region of the stem is known to attract RPW. Using controlled drip irrigation instead of open flood irrigation is therefore recommended. In homestead or landscape gardens, date palm stems should be insulated with polythene sheets at the base to prevent the splashing of water from sprinklers and other irrigation systems.

iv) Role of fertilizers in the management of RPW: Very little is known about the relationship between the RPW infestation and the application of macro (NPK) and micro nutrients (Zn,Si,Fe, Mn,Mg, soluble silica etc.). Some very preliminary results indicate that palms fertilized with diatomaceous earth could offer better resistance to infestation by RPW.

v) Palm density (spacing) in the field: Closely spaced palms, especially in the traditional grooves with limited penetration of sunlight, offers a suitable micro-climate for RPW, probably due to enhanced in-groove humidity. Adopting a higher spacing of at least 8x8m could be useful.

vi) Varietal selection: Host plant resistance is not exploited for the management of RPW. Farmers cultivate certain traditionally established date palm varieties and RPW is known to have a differential preference for palm varieties in the field. National research institutions should carry out studies to identify the factors of resistance and incorporate these in the traditionally cultivated varieties.

vii) Repellents of RPW need to be studied to prevent infestation in new areas.

viii) Preventive agronomic practices with respect to ornamental palms needs separate protocol.

5. Control Practices

RPW management in the field revolves mainly on the following control measures. All control operations should be supported by GIS based data collection and management system.

5.1. Mechanical sanitation

Palms that are not too deeply infested (terminal bud not infested when infestation starts by the canopy leaves bases, trunk not too deeply damaged by the larvae when infestation starts from the offshoots, aerial roots or petiole remains) can be sanitized either by insecticide injection or by mechanical sanitation. The purpose of mechanical sanitation is to eliminate the tissues where the larvae are, as well as to locate and destroy all the cocoons and adults. For tall ornamental palms (infestation is located in the canopy leaf bases), a precise and efficient protocol should be developed. For date palms, mechanical sanitation is practiced for many years, very simply with hand tools. When the detected symptom of infestation is the drying of leaves or offshoot, it is sometimes sufficient to remove and destroy the offshoot to sanitize the palm. When the larvae has passed from the offshoots to the trunk or when the infestation has started from the petiole remains, infested area must be eliminated with a sharp tool till reaching the healthy tissue. The infested tissue, if cut into small pieces does not need further treatment (the eggs and the larvae will die quickly in drying tissue). This simple mechanical sanitation presents two great advantages: it can easily be done by the farmer itself and no infested tissues are moved outside the infested area that avoids any risk of adult RPW spread. Furthermore, in case of slight and superficial

damage, the tissue is removed from the palm and destroyed. Thereafter the wounded palm tissue is sprayed with a repellent insecticide or clay or gypsum paste to avoid attraction of females.

As, in some places, very complex protocol have often been recommended regarding the issue of wasted infested tissues, it would be perhaps desirable that very simple experimentation be implemented to demonstrate the absence of risk presented by larvae or eggs present in wastes cut into small pieces. Some new technologies have been proposed to sanitize infested palms but they don't seem to present any advantage compared with the existing techniques.

5.2. Preventive insecticide applications (chemical/natural)

Preventive insecticide applications are currently either carried out through chemical or natural origin products. They have two purposes: (i) to kill the adults hidden at the bases of the leaves; and (ii) to protect the palms by killing adult female weevils and early stages of the pest.

Preventive insecticide applications must be applied either as by showering/soaking targeted zones of the palms or by injection (only for ornamental palms). To ensure the efficiency of the preventive insecticide treatments and minimize hazards on human health and the environment the following points should be respected:

- Preventive insecticide treatments should be applied only on the palms of the delimited infested area and during a limited period of time established according to the evolution of the traps captures.
- A range of insecticides should be tested and registered against RPW for each country.
- Attract and Kill products may be registered as a preventive semiochemical treatment
- There is a need for further testing of natural products against RPW.
- The dose and frequency of treatment for each registered pesticide against RPW to ensure proper use in the field operations.
- The following measures should be considered while taking up preventive insecticide applications.
  - In case of showers/soaking the pesticide solution should be targeted to the base of the leaves of the crown (ornamental palms of more than 2 meters) and inner leaf whorls, trunk up to 2 meters and offshoots (date palms and small ornamental palms).
  - For ornamental palms the option of attaching pipes to deliver showers of pesticides to the crown leaf bases requires periodic shifting.
  - For ornamental palms treatments by injection should not be considered as a routine technique as they create permanent wounds. They should be applied only for limited number of times and only in the frame work of program conceived and apply to obtain quick eradication of the pest. For date palm, injection should not be applied as for the moment no official data are available on the issue of insecticide residue content in the dates after injection.
- Pesticide residue studies should be done in palm tissues and especially in dates before registering any new pesticide for use in control program.

5.3. Curative insecticide treatments (chemical/natural)

- All relevant points mentioned under 5.1 should be applied.
- Need to develop a protocol for the rationale use of curative insecticide applications especially with regard to stem injection.
- Existing protocols of different countries should be reviewed and validated by specialists/experts in the field.
- Natural pesticides should be tested after details on the composition of the product are known.

5.4. Mass trapping

RPW pheromone traps capture only part of the weevil population in the field. Recently black colored traps have been reported to record superior weevil captures, while with regard to trap design, the dome shaped trap records significantly higher captures as compared to the traditional bucket trap. The synthetic kairomone (ethyl acetate) when added as a component to the RPW food baited pheromone trap is known to enhance weevil captures. Periodic replacement of the food bait and water, limits the need of increasing the number of pheromone traps in the field, besides significantly increasing the cost of an area-wide mass trapping program. In some countries mass trapping could be taken up by lead/trained farmers. Numbering of every pheromone trap in the field is essential for systematic data collection and processing. This could be realized by geo-referencing the traps and use of the Radio Frequency Identification (RFID).

Service-less trapping options based on ‘attract and kill’ and use of a dry trap based on ‘electro-magnetic radiation’ have been found promising in Saudi Arabia as an additional component of the RPW-IPM mass trapping program. Further evaluation of attract and kill technology and the dry trap using electro-magnetic technology should be considered where ever it is not yet tested.

5.5. Biological control

For the moment, no biological control solutions have been successful when applied at a significant field scale and for a long period of time. For the preventive treatment of ornamental palms in urban environment where this type of solutions have been strongly encouraged, these solutions have been abandoned after few years because of the cost and the difficulty of application that represent implementing the treatment several times per year.

In general, the delivery systems for biological control agents (such as entomopathogenic fungi) should be tested under laboratory and field conditions. Experiments to harden these biological agents to resist arid environmental areas are an essential factor for their success in the field.

It is recommended to test agents already approved in EU and to test natural products that could enhance the palm resistance.

New technology is also available for improving the longevity of *Beauveria bassiana* to heat and UV light in the field.

5.6. Removal and disposal of highly infested palms

The measures adopted to process the severely infested palms are very variable. In some places, infested palms are cut and totally shredded. The last operation requires the use of huge machines that are available only in few places where the infested palms have to be transported. Shredding machine generate a very high temperature to kill all the stages of the insect (egg – larva – cocoon – adult). Such protocol that is very heavy, complex to be applied safely (to avoid RPW spreading) and expensive has been adopted only in few places. For some years, it has been proposed that the procedure to be adopted should be based on a risk analysis approach. Better knowledge of the RPW biology during these last years has allowed establishing a very important point to take into consideration in the risk analysis which is that the larvae are not *xylophagous* and die very quickly in drying tissue. As in some places, very complex protocol has often been recommended regarding the issue of infested tissues removed from the palm, where it would be perhaps desirable that a very simple experimentation be implemented to confirm the absence of risk presented by larvae or eggs present in these palm tissues that are cut in small pieces.

In ornamental palms, the risk analysis approach has led to distinguish between the infested and non-infested parts of the infested palms. In case of the former (infested palm parts), specific protocols of intervention have to be adopted. For the later (non-infested palm parts) different types of protocols are adopted depend on the equipment available and the local conditions. Such approach based on risk analysis and taking into consideration the local conditions remain to be developed for date palms. Very simple protocol that can be managed at the farm level with very simple equipment has to be proposed.

It is recommended to assess and dispose such palms at the site itself by exploring the possibility of onsite hand small pieces chopping, incineration with mobile incinerator, mechanical shredding with small/mobile shredders. Removal and the disposal of infested palms' procedures should be further refined and developed.

6. Data management/GIS/validation

A turnkey solution for a data collection system is desirable that consists of (a) geo-referencing palm trees using Google Earth Engine and remote sensing, (b) use of mobile phones for data entry and transmission and (c) use of GIS for data management and analysis. A custom app should be developed for Android and iOS smart phones that would allow users to record geo-referenced data at the field location on a standard form. Ideally, users should use their own smart phone in order to avoid the procurement, distribution and management of unique devices. The app would use the GSM mobile data service (GPRS) to transmit the data from the field to a centralized national RPW office in real time. A specific procedure would be developed to allow automatic importing of field data into a custom GIS that contains a spatial database at RPW offices. The GIS would be used for the management and analysis of field and smart trap data in order to prepare maps, tables, charts and reports, and take necessary management decisions. Open-source, non-proprietary software such as PostgreSQL/PostGIS database and QGIS are suggested for the spatial database and GIS respectively. In this way, annual license fees are avoided, the GIS is platform independent (it can operate on Windows,

Mac, Linux), and a large pool of available developers and expertise can be utilized to customize the GIS to RPW requirements. The primary base map for the GIS should be a geo-referenced map of palm trees (output from item (a) above). This base map in combination with regularly updated and historical field data can be utilized to assess the current situation of RPW, monitor its incidence and geographical spread, act as an early warning system, make well-informed decisions, and research historical trends in order to better manage RPW.

Automated data flow and a GIS will permit to elaborate various types of maps, tables and graphs at different time periods and spatial resolutions according to the type of requested information.

These analytical tools are indispensable for an effective multi-regional programme/strategy to combat RPW at all levels.

It is proposed that FAO Headquarters takes the lead in this topic, learning lessons and adopting the experience from the Canary Islands system. A training program for different categories of the users of the tools (mobile apps, GIS, software) should be developed.

Periodic validation of the control program based on weevil captures in traps, infestation reports and GIS generated spatial and temporal models is essential for effective management of the pest, besides judicious use of men and material.

7. Stakeholder participation and involvement in the RPW control programs

7.1. Farmer involvement

In most of the RPW infested countries, the farmers/stakeholders are not or very little involved in the RPW control programs. In many countries, all the activities are implemented by Governmental agencies. These programs are very costly and have not succeeded to eradicate the pest or even to avoid its spread. In some countries, the activities of the authorities are limited to supply the farmers with some insecticide.

The advantage of involving the farmers in the control program is considerable as they present in the farm and can assist in detecting infested palms in early stage of attack, an action that constitutes the key to control and eradicate the pest. Furthermore, all or most of the activities of an RPW control program could be perfectly realized by them at a very low cost if they are well trained.

The strategy will assist the countries to develop a clear-cut policy on farmers/stakeholder participation and engagement in RPW-IPM programs. Pilot projects to experiment and demonstrate the feasibility to involve farmers/stakeholders should be implemented. The encouragement of the farmer participation in the IPM program should be supported by:

- Stakeholders mapping and needs analysis
- Implementing urgent studies, first, to dispose of a better knowledge of the socio-economic consequences of the RPW problem and of the farming systems in the infested areas, and, secondly, to propose adapted solutions to facilitate the farmers involvement.

- Strengthening extension programs, activities, knowledge sharing mechanisms, communications, farmers' organizations etc. for farmers/stakeholders.

- Improving the policies towards incentives to have a positive impact on a better marketing and incomes to farmers.

7.2. Role of cooperatives, NGOs and private sector

Government agencies working with RPW-IPM programs should establish defined linkages and coordination mechanism with cooperatives, NGOs and private sector to make the program more meaningful and effective. Involvement of oasis program in the RPW program in concerned countries is also recommended.

7.3. Institutional cooperation / networking

The national strategies should include a mechanism for strengthening the cooperation among institutions at the national level. Strong engagement and involvement of the law enforcement authorities and other stakeholder organizations is crucial for effective implementation of the phytosanitary measures and limiting the spread and risk of RPW.

8. Capacity building, communication and extension service

The RPW-IPM national strategies should include a capacity building programs, tailor made for different categories of stakeholders (farmers/workers and other stakeholders) involved in the implementation of IPM of RPW. The program should be enhanced by introduction of participatory approach (Farmers Field School) and demonstration fields for farmers and farm workers to empower them updated knowledge and field practices. One of the capacity building components should be the use of social media and mobile applications for knowledge and experience sharing. Periodic exchange of personnel to study and be exposed to on-going RPW-IPM program at the national level is vital for updating the knowledge and experience of the technical staff and farmers.

The regional RPW program will assist the countries in developing a capacity building programs and user friendly training materials with authentic, updated information in different languages to serve the needs of different categories of personnel and stakeholders.

One of the important components of the IPM program is the communication and extension service/program. Communication officers and extension agencies should be actively involved during the entire program to facilitate dissemination of information among all the stakeholders through different mass media. Use of social media to expedite transmission of information is essential to ensure the quick and wider outreach to all stakeholders and audience.

Different propagation tools and materials, such as short video messages, posters, bags and other gifts with easy and short messages to attract the attention and raise the awareness of different category of the public.

Extension agencies in each country or region can adopt some village or group of farmers and implement the RPW control program in its totality and showcase the benefits to other farmers. Such farms may be called model farms free of RPW where some field days could be organized to educate and demonstrate the technology to other farmer groups and regions.

There is a need to familiarize journalists to contribute to raising awareness. Social scientists and economists should be involved in the RPW management program.

9. Management and institutional set up

The national RPW control programs in most of the countries are operated by or under the supervision of the NPPOs of the Ministry of Agriculture (MoA). In some countries there are standalone centers/programs mandated to control RPW under MoA, while in other countries the responsibility of controlling RPW is implemented by different institutions under the supervision of different ministries with very weak coordination. It is also observed that palms for ornamental gardening that often harbor the pest come under the overall mandate of the municipality. Furthermore, in most of the countries, palms owners and farmers are not involved or very little in RPW control programs.

These factors result in the weak management of the pest. The Governmental administrative and bureaucratic set up also often impedes the smooth functioning and timely implementation of the national RPW control program. In most of the countries the implementation of the national program is challenging due to the shortage of both human and financial resources, while in some countries the control program is either partially or fully outsourced to private companies with weak monitoring, evaluation and supervision.

Furthermore, the national RPW control programs have almost no linkages with research institutions/universities working on RPW as a result of which the research output usually does not address the practical needs in the field.

For efficient functioning and operation of the national RPW control programs the concerned Governments should make provisions to address the above gaps in the management and institutional set up and develop a framework for coordination between the national RPW control program and other relevant Governmental and non-Governmental institutions and farmers groups.

10. Monitoring and Evaluation

Currently most of the national RPW-IPM Programs lack the component of the Monitoring and Evaluation (M&E). This has an adverse impact on the success of the programs, sustaining the positive results achieved and judicious use of resources.

The national strategies should be based on the Strategic Planning/Results Based Management approaches supported by a logical framework with clear key performance indicators and targets and M&E mechanism.

Monitoring is the systematic collection and analysis of information to track progress against set plans and targets, and check compliance to established standards. It helps identify trends and patterns, adapt strategies and inform decisions for the management of the program.

Evaluation involves identifying and reflecting upon the effects of what has been done, and judging the success. The findings of the evaluation will allow program managers, beneficiaries, partners, donors and other program stakeholders to learn from the experience and improve future interventions.

Monitoring and evaluation forms the basis for clear and accurate reporting on the results achieved by the national programs. Thereby, information reporting becomes an opportunity for critical analysis and organizational learning, informing decision-making and impact assessment of the programs. It is vital to involve key stakeholders as much as possible in the evaluation process.

In the context of the national RPW-IPM programs, it is recommended that a midterm and annual evaluation is carried out.

11. Research & Development

Recent references on RPW research are presented in Annex-1. The IPM national program should establish good cooperation with the research institutions and technology developers for sharing the information about the most recent results of research and innovations developed.

Different methods and technologies for the detection, surveillance and management of the RPW have been introduced in the recent years by the researchers and technology developers that have to be further evaluated and tested for their feasibility to be used in the field, as quick, user friendly and cost effective technologies.

The national RPW programs should include a component for testing and validation of recent innovative techniques and methods management of the RPW including trapping techniques, preventive and curative chemical treatments, quarantine protocols etc. that would facilitate the work and improve the effectiveness of the program.

II) Result Matrix of the Action Plan

	Indicators	**Targets**	**Time frame**	**Regional Program/ expected contribution**
Output 1	**Phytosanitary (quarantine) measures effectively enforced**			
Activity 1.1. Review of the national phytosanitary system in relation to RPW control	Phytosanitary systems reviewed	Strength/gaps of the system are identified and communicated to FAO	July 2017	Support in the review and assessment of the systems
Activity 1.2. Review/update/develop clear regulations for import requirements as well as phytosanitary measures to regulate the movement of palms within the country	Number of regulations are reviewed/updated/ developed	Report on the regulations reviewed/developed with their drafts reported to FAO	September 2017	FAO/IPPC could help in review/develop the regulations based on the ISPMs
Activity 1.3. Develop clear inspection and treatment protocols/guidelines for offshoots and palms with procedures for strengthening quarantine inspection at borders and plant protection services	Number of protocols/guidelines developed	Report on the protocols/guidelines developed with their drafts reported to FAO	September 2017	The Regional Program could help in developing of the protocols/guidelines
Activity 1.4. Develop guidelines for establishing commercial date palm nurseries and put in place a system for date palm nurseries' registration and certification	Number of guidelines for establishing commercial date palm nurseries and registration and certification system put in place	Country reports of the developed guidelines and registration and certification system put in place submitted to the FAO	January 2018	The Regional Program could help in developing of guidelines and registration and certification systems

Activity 1.5. Support the establishment of facilities for production of tissue culture palms	Number of facilities for production of tissue culture palms established in the countries	Reports from the countries about the progress in establishing the tissue culture facilities	Continuous activity	
Activity 1.6. Put in place a mechanism for strengthening the coordination and engagement of all law enforcement agencies and other stakeholders for enforcing of the phytosanitary regulations	Mechanism for strengthening the coordination and engagement of all law enforcement agencies is developed	The national RPW-IPM program is supported by clear mechanism for engagement all law enforcement agencies and other stakeholders	End of December 2017	
Output 2	**Early detection, surveillance and monitoring capabilities improved**			
Activity 2.1. Develop a harmonized technical protocol for visual inspection, and involve farmers and other stakeholders in the process of early detection	Number of technical protocols for visual inspection developed by the countries	At least 3 protocols are developed by each country and submitted to regional program for review.	September 2017	The Regional Program could help in developing technical protocols for visual inspection
Activity 2.2. Assess and test new advanced technologies being developed for early detection	New advanced technologies tested/adopted by the countries	Report on the new technologies tested/adopted submitted by the countries	Continuous activity	
Activity 2.3. Develop a clear protocol/program for the surveillance and monitoring based on the International Standard for Phytosanitary Measures (ISPM 6), including guidance for surveyors and	National surveillance and monitoring program developed by the countries	Repot on the surveillance and monitoring program developed based on the ISPM6	October 2017	FAO/IPPC could help in review/developing the surveillance and monitoring programs

inputs/resources needed.				
Activity 2.4. Deploy a mobile application and GIS aided monitoring system for efficient mapping, data collection, analysis and management of the surveillance and monitoring program.	The mobile application and GIS is developed by FAO and made available to the countries	The mobile application and GIS is operational and used by member countries	March 2018	Secretariat of the Program with support of FAO-CIO will assist in developing the system and make it available for the countries
Output 3	**Preventive and control measures improved**			
Activity 3.1. Prepare national guidelines for adopting good agronomic practices (palm density in the field, irrigation, crop and field sanitation etc.) for the management of RPW	Number of national guidelines for adopting good agronomic practices to control RPW developed	Report on guidelines for adopting good agronomic practices to control RPW submitted by member countries	October 2017	The Regional Program could assist member countries
Activity 3.2 Standardize national guidelines for preventive (sprays/showers/stem injection) and curative (chemical & mechanical sanitization) treatments against RPW	Number of guidelines for preventive (sprays/showers/stem injection) and curative (chemical & mechanical sanitization) developed by member countries	Report developed on guidelines for preventive (sprays/showers/stem injection) and curative (chemical & mechanical sanitization)	October 2017	The Regional Program could assist member countries
Activity 3.3 Develop a list of registered pesticides for RPW that have undergone the national registration process	List of registered pesticides for RPW that have undergone the national registration process developed in each country	Annual reports on the list of registered pesticides for RPW that have undergone the national registration process	Annual activity	

Activity 3.4. Identify national laboratories/agencies to carry out and authenticate pesticide residue analysis in date and other palms	National laboratories/ agencies to carry out and authenticate pesticide residue analysis in date and other palms identified	Report on national laboratories/agencies and results of pesticide residue analysis in date and other palms submitted by member countries	Annual activity	
Activity 3.5. Develop and standardize RPW pheromone trapping protocols with respect to trap design, trap density and servicing	Current status of RPW pheromone trapping protocols standardized	Report on the RPW pheromone trapping protocols submitted by countries	October, 2017	
Activity 3.6. Test new RPW trapping technologies, including smart traps, geo-referencing the traps, use of the Radio Frequency Identification (RFID), and service-less options including 'attract & kill' and electro-magnetic traps	New RPW pheromone trapping technologies tested	Report on the new RPW pheromone trapping technologies tested is submitted by the countries	Continuous activity	
Activity 3.7. Develop and adopt a simple protocol for proper and safe removal of infested palms that can be managed at the farm level with simple equipment	A protocol for proper and safe removal of infested palms developed using simple techniques developed member countries	Report on the protocol for proper and safe removal of infested palms submitted by member countries	December, 2017	

Output 4	***RPW-IPM program institutional capacity, planning and implementation enhanced***			
Activity 4.1. Develop and adopt a 'participatory approach' plan for enhancing participation and engagement of the farmers/stakeholders in the national RPW-IPM programs	A plan for enhancing participation and engagement of the farmers/stakeholders in the national RPW-IPM programs developed by each country	Report on the participatory approach' plan in the national RPW-IPM programs received from each country	October, 2017	
Activity 4.2. Establish a coordination, communication and networking mechanism with other national stakeholders (Governmental agencies, research & academic institutions, cooperatives, NGOs and private sector)	Coordination, communication and networking mechanism with other national stakeholders developed	Report on the coordination, communication and networking mechanism with other national stakeholders submitted by member countries	October, 2017	
Activity 4.3. Develop a national capacity building program tailor made for the personnel working in the RPW-IPM program, farmers, law enforcement agencies and other stakeholders	A national tailor made capacity building program by member countries under the national RPW-IPM program developed	Capacity building programs are developed by member countries under their national program	Continuous activity	
Activity 4.4. Develop user friendly training and awareness raising material including digital applications in a simple language of the targeted categories	User friendly training and awareness raising material developed by the countries	Need based user friendly training and awareness raising material to support the national RPW-IPM program developed by member countries	Continuous activity	

Activity 4.5. Develop pilot projects for the area-wide management of RPW that could be implemented in a farmer-participatory mode for oases communities utilizing the 'Farmer Field Schools' approach	Number of pilot projects for the area-wide management of RPW in farmer participatory mode developed by the countries	Report on pilot projects for the area-wide management of RPW implemented by the countries	Continuous activity	The Regional Program could assist member countries
Activity 4.6. Improve the RPW-IPM program planning and implementation by adopting a result based management approach (RBM) including efficient monitoring & evaluation with adequate allocation of resources and means	Number of RPW-IPM programs developed/reviewed based on RBM approach	The national IPM strategies are developed based on RBM with M&E plans and reported to FAO	May, 2018	The Regional Program could assist member countries in the review/development of the programs based on RBM

B. GLOBAL AND REGIONAL COMPONENTS

1. Global platform

A global Red Palm Weevil Management Platform will be established for the purpose of strengthening the coordination, information, experience and knowledge sharing at the global level. The global platform would:

- strengthen the coordination between member countries in early warning, information and knowledge sharing for effective management of RPW;
- promote environmentally safer RPW management tactics to minimize the risks of control operations on human health and environment;
- establish a repository of experts on RPW;
- facilitate the exchange of the research results, innovative technologies on monitoring, detection and management of Red Palm Weevil.

The Global Platform will be established with support of FAO, CIHEAM, IPPC and other partners and member countries, and could be hosted by FAO.

The platform will be open for partnership and cooperation with other stakeholders including regional and international organizations, research institutions, NGOs, private companies, etc.

A proposal for the establishment, operational scheme and contribution of members of the platform would be prepared by FAO and CIHEAM and shared will all countries and organizations for interest and contribution.

2. Regional Program for Red Palm Weevil Management in NENA Region

For the purpose of supporting the implementation of the proposed strategy, a Regional Program for Red Palm Weevil Management will be established to create an enabling environment for cooperation and coordination, and assist the member countries of the NENA Region to improve their management strategies and programs of RPW management.

The Regional Program could be established and hosted by the FAO Regional Office for Near East and North Africa Region with support of CIHEAM, NEPPO and member countries.

The program would:

- strengthen the cooperation and coordination between member countries in early warning, information and knowledge sharing for effective management of RPW;
- assist in developing programs, guidelines and protocols for prevention, early detection, rapid intervention and management of the RPW and support the countries for their implementation;
- assist in developing approaches, strategies, methods, training tools to increase the involvement of the farmers in the RPW management;
- provide *ad hoc* capacity building programs and technical assistance to the national RPW management programs;
- support the member countries in preparing and implementing Monitoring and Evaluation (M&E) plans;
- develop GIS spatial database for data management and analysis with a mobile application for data collection and transmission that could be adopted by each country;
- support the countries in developing of harmonized phytosanitary measures and contingency planning approaches to eradicate RPW or to contain its spread;
- assist in building the human and institutional capacity of the national programs of member states;
- support and coordinate joint activities at regional level (joint surveys and management programs) and inter-regional level to foster cooperation and exchange of field experience among RPW national schemes/projects;
- promote environmentally safer RPW management tactics to minimize the risks of control operations on human health and environment;
- support studies on generating data on pesticide residues in fruits (dates, coconut etc.) and provide and share information on permissible limits for different classes of pesticides;
- support the research and development programs for promotion and validation of the innovative, safe and cost-effective technologies;
- establish a repository of experts on RPW;
- develop programs for resource mobilization to support the operation of the program.

2.1. Beneficiaries and stakeholders

The Regional RPW Program will facilitate and improve the cooperation and knowledge sharing between the member countries and provide technical assistance to member countries to improve their RPW-IPM programs.

The program will be open for partnership and cooperation with other stakeholders including farmer cooperatives, NGOs, private companies, research institutions etc. for promoting the national RPW-IPM strategies, and developing and validating of advanced management technologies. The gender issue will be considered in the strategy.

2.2. Operation of the Regional Program

- The Secretariat of regional program could be established and hosted by FAO.
- Member countries should identify a national focal point for the coordination, communication and for representing the country in the regional program.
- A trust fund account should be created by FAO for the financial contribution of the member countries and organizations to support the establishment, operation and activities of the regional program.
- The regional program should conduct an annual meeting of the member countries to;
  - Assess yearly development of the RPW situation and the efficiency of the programs at the regional level.
  - Develop the annual program for the regional program based on national and regional priorities.

2.3. Action plan of the regional program

	Time frame	**Responsibility**	**Estimated Budget USD**	
			One Time Cost (Non-recurring)	**Recurrent Annual Operational Cost**
Output 1	**A regional RPW regional program is established**			
Activity 1.1. Establishment and endorsement of the RPW regional program by the member countries	By end of June 2017	FAO, CIHEAM, NEPPO and Member countries		
Activity 1.2. Nomination of the Secretary of the RPW regional program and establishing of the secretariat	By end of June 2017	FAO, CIHEAM and NEPPO, Member Countries		Salary of the Secretary and Secretariat expenses

Activity 1.3. Nomination of national focal point and identification of the countries' contribution and commitments	By end of July 2017	Member countries		
Activity 1.4. Prepare the statutes of the regional RPW program	By end of July 2017	FAO, CIHEAM and NEPPO		
Activity 1.5. Create a trust fund account for the regional program	By end of July 2017	FAO and CIHEAM		
Activity 1.6. The first meeting of the RPW regional program to agree on the statutes, confirm the countries contribution and develop the annual program.	By end of September 2017	FAO, CIHEAM, and NEPPO Member countries	60, 000	
Output 2	**The regional RPW program is fully operational**			
Activity 2.1. Develop the three-year strategic framework for the program, and annual work plan program with clear performance indicators and targets.	By end of December 2017	- Secretariat of the program and national focal points of member countries - Clearance of FAO, CIHEAM and member countries	20,000	
Activity 2.2. Assist member countries in planning, implementing and validating of RPW national control programs	Continuous activity	Secretariat of the Program with support of specialized experts		50,000

Activity 2.3. Establish a RPW network with a data base for sharing information and knowledge.	By end of March 2018	Secretariat of the program with support of specialized FAO Divisions and CIHEAM	20,000	
Activity 2.4. - Develop and implement a methodology based on Google Earth, remote sensing and other technologies to geo-reference the location of palm tree plantations as the basis for mapping and monitoring infestations in a GIS - Develop a mobile application for data collection and transmission - Develop a GIS with a spatial database for data management and analysis	Within one year of establishment of the program	Secretariat of the program with support of FAO-CIO	150,000	
Activity 2.5. Provide the countries with the technical assistance needed and capacity building programs	Continuous activity	Secretariat of the program with support of specialized experts and institutes		150,000
Activity 2.6. Prepare proposals for resource mobilization and follow up with donor agencies for funding	Continuous activity	Secretariat of the program with support of specialized experts		
Activity 2.7. Facilitate the coordination and communication with national, regional and international research institutions for validating and testing	Continuous activity	Secretariat of the program		

new technologies of RPW management.				
Activity 2.8. Assist the countries in preparing the technical resources on RPW management (regulations, guidelines and protocols)	Continuous activity	Secretariat of the program with support of specialized experts, FAO Divisions and external institutes		50,000
Activity 2.9. Develop and support implementation of a Monitoring & Evaluation plan for the evaluation of the national RPW programs	Annual activity	Secretariat of the program		10,000
Activity 2.10. Conduct annual meeting of the program	Annual activity	Secretariat of the program		50,000
Activity 2.11. Publish the annual report on the development of the RPW situation in member countries	Annual activity	Secretariat of the program		5,000
Total estimated budget without salaries of staff			**250,000**	**315,000**