

**Report of the FAO Regional Training Workshop for Farmer Field School facilitators on sustainable management of Fall Armyworm: IPM, Biocontrol and Farmer Field Schools, November, 2020 (LOA RAP/2019/19)**

**Submitted by Thai Education Foundation**

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## Table of Contents

Acronyms .....	3
Summary:.....	4
A. Background and Introduction.....	4
B: Minutes from the FAW Webinar Series.....	5
B.1: Webinar #1 (Thursday October 29, 2020) .....	5
B.2: Webinar #2 (Tuesday November 3, 2020).....	9
B.3: Webinar #3 (Friday November 6, 2020) .....	13
Annex I: CONCEPT NOTE: Regional Training Workshop for Farmer Field School facilitators on sustainable management of Fall Armyworm: IPM, Biocontrol and Farmer Field Schools .....	18
Annex II: List of Participants .....	23
Annex III: Feedback from participants.....	32
Annex IV: Summary of National baseline studies for Fall Armyworm (FAW) control (November 2020) .....	34
Part I.1 – National level coordination .....	34
Part I.2 – FAW infestation and impacts on maize production .....	35
Part I.3 – Capacity for FAW management.....	36
Part I.4 – Monitoring, early warning and prevention of the further spread of FAW.....	39
Part I.5 – Comments from the National Task Force .....	39
Part II. Additional questions with specific relevance for the forthcoming FAW-IPM-biological control and Farmer Field Schools webinar series (as sent out in October 2020) .....	40
Annex V: List of and Links to materials on FALL ARMYWORM .....	42

# Acronyms

<b>BPI</b>	<b>Bureau of Plant Industry (Philippines)</b>
<b>CABI</b>	<b>Commonwealth Agricultural Bureaux International</b>
<b>CYMMIT</b>	<b>International Maize and Wheat Improvement Center</b>
<b>DA</b>	<b>Department of Agriculture</b>
<b>FAO</b>	<b>Food and Agriculture Organization of the United Nations</b>
<b>FAW</b>	<b>Fall Army Worm</b>
<b>FAWMEWS</b>	<b>Fall Army Worm Monitoring and Early Warning System</b>
<b>FFS</b>	<b>Farmers Field Schools</b>
<b>ICT</b>	<b>Information and Communication Technology</b>
<b>IPM</b>	<b>Integrated Pest Management</b>
<b>MARD</b>	<b>Ministry of Agricultural and Rural Development (Vietnam)</b>
<b>NGO</b>	<b>Non-Government Organization</b>
<b>NPV</b>	<b>Nuclear Polyhedrosis Virus</b>
<b>PPD</b>	<b>Plant Protection Department (Vietnam)</b>
<b>TEF</b>	<b>Thai Education Foundation</b>

# Report of the Regional Training Workshop for Farmer Field School facilitators on sustainable management of Fall Armyworm: IPM, Biocontrol and Farmer Field Schools (LOA RAP/2019/19)

## Summary:

In late 2020, the Thai Educational Foundation (TEF) -with support from the UN Food and Agriculture Organization (FAO)- organized an online Regional Training Workshop for Farmer Field School facilitators on sustainable management of Fall Armyworm (FAW). A three-day webinar series was conducted with each session lasting for approx. 2.5-3 hours. Each session was attended by approx. 50 participants, including representatives of government, academia, NGOs, international institutes from across the Asia-Pacific region. Sessions comprised short presentations by experts and/or country delegations on covered a broad suite of topics, group discussions and interactive Q &A sessions.

Overall, the training event successfully attained its core objectives, i.e., 1) raising awareness about the newly invasive pest and its main Integrated Pest Management (IPM) solutions, 2) transferring information about suitable FAW monitoring tools and protocols, including FAO's FAMEWS application, 3) infusing Farmer Field School (FFS) curricula with agroecological concepts / tactics, and 4) exploring opportunities to fortify training of trainers, FFS and other hands-on learning courses. Furthermore, government personnel, FFS facilitators and researchers actively engaged in the sessions and were able to share their experiences on pest monitoring / surveillance, farmer training and sustainable FAW management. Participants identified certain needs for future FAW activities included sharing of training curricula, resource materials, upcoming webinars or training events and support for bio-control development and experiments.

## A. Background and Introduction:

In November 2019, The Thai Education Foundation was commissioned by the FAO Regional Office for Asia and the Pacific (FAO-RAP) to organize a field-based training workshop for farmer field school facilitators on sustainable management of Fall Armyworm (*Spodoptera frugiperda*). The workshop was to focus on IPM, Biocontrol and Farmer Field Schools and to be held in Chiangmai, Thailand in April, 2020. It was anticipated that approximately 30 participants from 12 countries from South and Southeast Asia countries would be invited to participate in this workshop. Meetings, coordination and field preparations were arranged. However, due to the Covid 19 pandemic and associated travel restrictions, the workshop was postponed to late 2020 and the LOA was extended till November 30, 2020. Finally, in July, 2020, FAO and TEF decided to redesign the field-based workshop into Webinar series in order to facilitate the needs and objectives of the workshop. TEF began to work with consultants and designed the webinar program consisting of 3 session. The agenda was designed to enable participants to gain knowledge of Global, regional and countries' status of Fall Armyworm and to facilitate sharing of up-to-date innovations for FAW prevention and management including relevant trainings and strategies and plans for farmers' education programmes. See **Annex I: Concept note and agenda for more details.**

TEF team of consultants regularly met in virtual meetings to plan, recruit and prepare presenters and facilitators for the webinar sessions which were organized on October 29, November 3 and November 6<sup>th</sup>, 2020. A detailed account of workshop proceedings and outcomes is provided in report **section B** below.

As a result, over 70 participants from 25 countries participated in the programme with at least 40 participants stayed until the end of the 3 hours sessions. Majority of participants expressed positive feedback to the relevancy, effectiveness of the webinar programme and identified needs for future communications and information. See more details in **Annex 2: Feedback from participants**

Questionnaires were sent out to AP countries to solicit feedback on an updated FAW status, plans and strategies to be compiled and shared during the webinar programme. A summary of major survey findings is provided in **Annex 3: Global Action for Fall Armyworm (FAW) control Summary of National baseline studies (November 2020)**

In addition, a training consultant was hired to develop list of relevant materials and guidance to be shared and uploaded onto TEF website (<https://www.thaied.org/resources/>). The list of training resources is provided in **Annex 4: List of and Links to materials on FALL ARMYWORM**

## **B: Minutes from the FAW Webinar Series**

Below follows a detailed account of the minutes of the entire FAW webinar series.

### **B.1: Webinar #1 (Thursday October 29, 2020)**

#### **1. Introduction of FAW regional webinars**

Opening comments by **Marut Jatiket** (Thai Education Foundation), explaining the overall scope, modus and goals of the webinar series. **Dr. Yubak GC** (Senior Plant Protection Officer, FAO RAP) emphasizes how multiple efforts are underway to limit spread/damage of fall armyworm, underlining a need for global action and for regionally coordinated initiatives. Through this webinar series, we intend to share knowledge of FAW biology, ecology and management beyond a single country and beyond the Asia-Pacific region. Expresses his thanks to the organizers, moderators and presenters in the webinar series. Marut Jatiket further gives a bird's eye view of the anticipated content of the 3-day webinar.

**Kris Wyckhuys (Chrysalis Consulting)** gives an opening talk – intended to set the stage and illuminate how the FAW invasion presents a unique opportunity to revitalize IPM and advance biological control. Fall armyworm is a polyphagous herbivore, an occasional pest in a range of economically-important crops, and features among the top-15 insecticide-resistant pests globally. Considering the important area-wide implications of good, ecologically-based (or bad, insecticide-reliant) management of fall armyworm, there are clear opportunities for regional collaboration, South-South information exchange and active adaptive management. Hand-in-Hand action across the Asia-Pacific region is a must.

It is important to recognize that FAW-impacts are felt along the maize value chain & that this value chains needs to be engaged in pest management (and funding mitigation programs). Though FAW does exhibit conspicuous and often dramatic feeding damage, its yield impacts may be low to moderate. Hence, the need to carefully assess yield losses and measure economic impact. Different approaches exist to monitor FAW spread dynamics, including FAO's FAMEWS app. In the FAW native range (i.e., Americas), farmers do not perceive it as a pest and refrain from pesticide use, while the pest is kept at bay through the action of a

diverse complex of natural enemies. Ecological balance is key to control fall armyworm in its invaded range (e.g., Asia) either through importation biological control or by enhancing the action of endemic (generalist) natural enemies. Integrated pest management (IPM) helps preserve ecological balance / with IPM being the tactical integration (and deliberate prioritization) of pest management practices to lower pest populations.

IPM is structured as a pyramid, with a firm basis of 'preventative' measures and avoidance tactics. Several silver bullets exist under IPM: 1) biodiversity as a first line of defense of the agro-ecosystem, 2) diversification of corn agro-ecosystems e.g., through legume intercropping as a means of regulating FAW population, 3) biopesticides are safe for humans and the environment, and should be formally included in Insecticide Resistance Management (IRM) modules. On the latter topic, the use of nucleopolyhedrovirus (NPV) carries a lot of potential as an environmentally-sound, self-sustaining management tactic. It is essential to educate maize growers and empower farmer innovators.

**Buyung Hadi** (FAO RAP) gives a panoramic view of the Global Action (GA) against fall armyworm. In terms of FAW-induced damage, data from the field range from 11-22% yield loss (equating US\$ 18 billion per year in Africa). The GA target is to bring down FAW-related damage to 5% in demonstration countries and 10% in pilot countries. A delay of further spread is pursued through enhanced preparedness and phytosanitary measures. The key challenge is that conventional pesticides are the predominant management technique, with up to >80% households in certain African countries using (only) synthetic pesticides, with high reliance upon highly to moderately hazardous pesticides. In several countries, up to 50% households report pesticide-related health symptoms.

The promotion of "IPM as a pyramid" entails that insecticides are not necessarily needed every season. Good agronomic practices and conservation biological control are key. When selecting synthetic pesticides, it is recommended to consider health and environmental risks (as outlined by Jepson et al., 2019). IPM's Achilles heel are (locally-defined) economic thresholds and IRM schemes – lab diagnoses already reveal the presence of FAW resistance to multiple active ingredients. China, Philippines and India are demonstration countries, where 2021 action will be undertaken in collaboration with national partners.

**Jean-Claude Rwaburindi** (FAO RAP) introduces FAO's fall armyworm monitoring and early-warning system (FAMEWS). FAMEWS enables a regular monitoring of *Spodoptera frugiperda* populations, with the ultimate aim of supporting decision-making and preventing crop damage. FAMEWS consists of a mobile application (available on GooglePlay) linked to a global platform for data analysis, summarizing and real-time GIS mapping. The mobile application links to the PlantVillage Network, permits interaction with other FAMEWS users, and equally contains information on FAW biology / ecology and IPM technologies. At present, FAMEWS is available in 29 languages and collects crowd-sourced data obtained through field scouting or pheromone-based traps.

The FAMEWS app contains an artificial intelligence module through which image recognition is used to identify FAW damage in the field. Tailored advice is provided on FAW management, e.g., including images of natural enemies. The app equally visualizes country-level and regional patterns in e.g., FAW incidence, trap capture level.

**Alison Watson** (GrowAsia) presents on behalf of Dr. Bui Xuan Phong (Vietnam PPD) the ASEAN FAW Action plan. Farmers are in urgent need of effective, locally valid and regionally relevant management solutions. FAW Action Plan was recently endorsed by ASEAN ministers. Three overarching goals: 1) reduce FAW-induced crop losses and livelihood impacts, 2) promote sustainable and cost-effective IPM, and 3) drive coordinated and effective multi-stakeholder communication. Six objectives and six workplans are to be pursued. A core budget of \$750,000/year is now being secured. Core projects include avenues for efficient regulation pathways, women as IPM leaders, building capability within the enabling environment, farmer communication / learning facilitation, and the establishment of a FAW knowledge & innovation hub.

Flagship projects include a) regional resistance management plan, b) regional monitoring and surveillance platform, c) biocontrol opportunities with IPM and d) technology transfer.

## 2. Status and innovations in FAW IPM and biological control

**Wilma Cuaterno** (BPI, Philippines) presents her country's national action plan. In the Philippines, there's currently 2.5 million hectares comprising both conventional and GM varieties. FAW has been confirmed in 267 municipalities in 57 provinces – primarily affecting corn. Smallholder farmers are at the frontline in FAW management; they need to be empowered and informed about proper field scouting protocols and suitable IPM practices. Crisis management team has been established within the Department of Agriculture (DA). The Philippine FAW IPM can serve as an example for future mitigation of endemic / invasive pests. Prevention & avoidance actions are multi-pronged, involving FAW awareness-raising campaigns, pest advisory, plant quarantine measures (e.g., enforcement of quarantine regulations), crop diversification, synchronous planting and field sanitation.

Early detection entails the use of trap crops (legumes) 20 days before main crop establishment, field inspection, use of pest attractants. Surveillance includes the identification of hotspots (through field surveys) and field scouting / surveys through FAO protocols. On suppression, early FAW infestation can be addressed through physical methods (manual control, sand/ash, incentivized collections), biological control and pesticide (spot) applications. Basic research is being carried out by academia, while DA centers are conducting applied research e.g., on monetary loss assessments, pesticide efficacy trials. A FAW information database will be established and networking will be done with a range of national / international stakeholders.

**Ivan James Pintokasan** (DA, Philippines) reports on the outcomes of different FAW workshops – tailored to different types of stakeholders. Farmers are trained in conducting field surveys during different maize phenological stages and become familiar with either UV light traps or pheromone traps. On management, a number of biological / manual management practices are being transferred to participants. In IPM-FFS facilitator training, ToTs learn how to identify different developmental stages of FAW. Specific training events are held on FAW surveillance / monitoring, again entailing FAW identification, surveillance and monitoring procedures and optimum management strategies.

Insect zoos are used to familiarize participants e.g., with biological control agents such as *Telenomus* spp. Hands-on exercises are done to visualize the hazards of pesticide exposure to farmer applicators, or to observe efficacy of particular insecticides. Farmer field schools (FFS) have been set up in 5 different sites, with weekly training events scheduled from early October 2020 onward with an evaluation of different IPM technologies (e.g., ash application, sugar water, vinegar, parasitoid releases, botanical insecticides) in conventional, glutinous and sweet corn varieties.

**Dr. N. Bakthavatsalam** (ICAR, India) gave a very exciting overview of bio-intensive / non-chemical management of fall armyworm in his country. India has 9.4 million ha under corn production with comparatively low yield levels (average 3.1 t/ha). FAW was first recorded in 2018 in India and is now present in all states except Jammu and Kashmir, affecting maize, sorghum, sugarcane (and occasional occurrence on cotton and rice). India is blessed with a wide diversity of natural enemies, including multiple (endemic, generalist) parasitoid species. In southern India, parasitism percentages in southern India are steadily increasing up to 18-20% for different species. In northeastern India, very high levels of (natural) biological control are recorded with 56-73% larvae either parasitized or infected with entomopathogens. Rearing technologies are being refined for *Trichogramma chilonis*, *T. pretiosum*, *Telenomus remus* - quality of reared wasps is high with 90% emergence under field conditions. Earwigs and different Pentatomid species are found to be good FAW predators.

Several microbial pathogens and NPV have been field-tested, with Bt sprays yielding up to 85-88% control under field conditions and different *Metarhizium* sp. strains resulting in 55-80% population reduction. A number of fungal pathogens and NPV strains are occurring naturally in local maize fields. Up to 90% pest population reduction is achieved with NPV strains. Entomopathogenic nematodes under granular formulation are yielding similar levels of control as chemicals such as emamectin benzoate. IPM trials have shown excellent results by integrating pheromone traps, parasitoid releases, entomopathogen sprays and application of botanical pesticides. The above measures are now being evaluated under large-plot trials in two villages. Overall, Indian research shows that little or no synthetic pesticides are needed to manage fall armyworm; for effective natural enemies, mass-rearing units need to be established.

**Zhenying Wang** (IPP-CAAS, China) covers the status and innovations in FAW IPM in China. Dr. Wang emphasizes how China's government was quick to raise awareness and to mobilize action against FAW invasion, with training courses organized and alerts sent in late 2018 by the Department of Agriculture to Guangxi and Yunnan provinces. Following the FAW arrival in early 2019, searchlight traps, UV light traps and pheromone traps were deployed in Yunnan, Guangxi and Guangdong provinces. Research groups were quickly set up and video conferences were organized for monitoring/early-warning, chemical control, biological control, varietal resistance, et. Field demonstrations were run in different provinces, including in Yunnan. Unfortunately, due to technical difficulties / connectivity issues, Prof. Wang was unable to complete his presentation.

### 3. Summary of GrowAsia / CABI webinar series on biological control

**Alison Watson** (GrowAsia) covered the webinar series on biological control – under the ASEAN Action Plan and its biological control flagship project. Three webinars were organized covering 1) classical biological control, 2) biopesticides and 3) augmentation / conservation approaches. More than 1400 people registered for the webinar series and 700+ attendees were logged at any given session. Lots of expertise is already present in the ASEAN region and these experts urgently need to be linked, as to enhance their ability to mobilize funding. Over the next few months, an 8+ technical workshop session will be organized together with CABI on different aspects of biological control. The development of a full-fledged biological control programme is anticipated and prioritized under the FAW ASEAN Action Plan.

**Malvika Chaudhary** (CABI, India) describes how CABI is partnering with several actors in the region to promote biological control, to enhance collaboration and to raise awareness. CABI is currently working with national partners to conduct field surveys, characterize genetic profiles of invasive FAW populations, establish solar-based trapping systems and to promote FAO's FAMEWS application. On biological control, different approaches are being pursued. For classical biological control, CABI is establishing collaboration with countries in the area of FAW origin, with view on an eventual introduction of exotic natural enemies (e.g., *Chelonus insularis*, *Eiphosoma laphygmae*). If an effective parasitoid can be identified (and passes ecological risk assessment), classical biological control could be especially cost-effective. Gel-based formulations are being evaluated of entomopathogenic nematodes, including the formulation and in-field efficacy assessment. In Myanmar, farmers heavily relied upon chemical pesticides with application frequencies of 8 times per season. IPM programs, promoted through participatory learning approaches, permitted a sharp reduction in insecticide sprays (to 2 applications of 'soft' chemicals) and improved farmer revenue.

Farmer education and public awareness-raising is critical to promote biological control. Indeed, most farmers are unaware about biological control and downplay the risks of chemical pesticides. Often, extension officers do not promote biological control. Mass extension tools, including posters, leaflets, social media campaigns and video have been developed for FAW mitigation. CABI also manages a research

collaboration portal, and Asia-Pacific scientists are encouraged to upload their information and findings. CABl's Biopesticides Portal further provides details on the local availability of biological control agents and biopesticides for a given pest. Many questions need to be asked regarding biological control, and its benefits should be highlighted especially as compared to synthetic pesticides.

## **B.2: Webinar #2 (Tuesday November 3, 2020)**

**Jan Willem Ketelaar** provides a summary of the previous session and then introduces the agenda for session #2.

**Kris Wyckhuys (Chrysalis Consulting)** then provides a summary of the responses to a joint FAO x TEF survey on national FAW mitigation responses, policies and action plans. Responses were received from 12 different countries, with full responses (to Part I and II) from 5 countries. In most countries, a national FAW task force has already been established, with some countries have a very detailed / comprehensive outline of its purpose. Countries had varying degrees of collaboration with national academia and international institutions; 4 countries worked closely with FAO. Most countries had attained low to intermediate levels of FAW awareness among different stakeholders – using a broad range of communication / extension strategies.

Although FAW infestation was recorded using different metrics, most countries report low to intermediate levels of pest pressure with yield losses between 2-6.5% (and 25-40% in hotspot areas). Economic impacts are shaped by FAW-induced yield loss and pesticide expenditure. On monitoring, many countries employ pheromone traps, while others invest heavily in field scouting or the use of FAMEWS apps. A range of (farmer) innovations are showcased by different countries, involving intercropping, biological control and baits. Though all countries confirm their endorsement of IPM, most invest heavily in insecticide-based approaches and critically disregard preventative, ecologically-based interventions. Multiple active ingredients that are endorsed are highly toxic, have been banned either globally or in western nations, and feature in the list of Jepson et al. (2019). Insecticidal treatments do not belong in the IPM toolbox and drone-based insecticide sprays are banned by several countries, yet these approaches are being promoted by multiple nations.

In half of the countries, IPM policies cover biological control and there's clear opportunities for South-South technology exchange and capacity building. There are clear opportunities for policy change, e.g., to prioritize farmer agro-ecological training, fast-track registration of biologicals, formally insert biopesticides in IRM schemes, take a clear stance on drone-based insecticide sprays and seed coatings.

**Siros Suwanmanee** (DoAE, Thailand) gives an overview of how the country's 800+ community pest management centers have played a central role in FAW mitigation. DoAE involves primarily in technology transfer and farmer extension; it has a presence in all provinces and districts, working closely with a range of national academic and government institutions. In 2020, training was conducted for 1000 farmers in 50 provinces, >2,300 farmers were trained on IPM. Lastly, IPM workshops were held for 130 regional officers. Leaflets, infographics, radio spots, Facebook Live and posters were developed to advance awareness-raising and farmer education.

A video presentation showcases Thailand's pioneering work in biological control against a range of pests, including fall armyworm. A visually appealing video introduces the different types of biological control, gives a sneak-peak into some of the country's mass-rearing facilities. Many naturally-occurring natural enemies of FAW have so far been recorded in Thailand. For augmentative biological control, *Bacillus thuringiensis*

endotoxins, stink bugs and earwigs can be used against *Spodoptera frugiperda*. Earwigs can be effectively used and a sound alternative to pesticide-based approaches.

In community pest management centers, farmers are learning about pest identity, biology and management and are being familiarized with different sustainable crop protection measures, including biological control. Farmer field school approaches are used to show how IPM needs throughout the growing season - from the time of field preparation up till crop harvest. Farmers learn how to conduct pest surveys (eggs and larval damage), deploy egg parasitoids or conduct releases of earwigs. At high infestation pressure, Bt sprays and Neem applications can be made.

**Pheophanh Soysouvanh** (Department of Agriculture, Lao PDR) indicates how maize is cultivated on >150,000 ha nationwide, with FAW primarily affecting maize production in northern parts of Lao PDR. Surveys were carried out in collaboration with FAO, training materials (e.g., brochures, posters, video) from FAO, LURAS and CIMMYT were adapted and distributed. Farmer training covered FAW biology, ecology, pesticide safety and the artisanal production of bait traps and botanical insecticides. Farmer action research was undertaken in one province, involving the in-field evaluation of different practices, e.g., plant extracts, Bt sprays, releases of chickens, predators or parasitoids. Stinkbugs and assassin bugs proved very effective for FAW control and lend themselves for (cottage-style) on-farm production. Ms. Pheophanh further emphasizes that the objective of training programs should be IPM of maize pests, instead of solely focusing on FAW.

**Timothy Krupnik** (CIMMYT, Bangladesh) covers USAID-supported activities against FAW in Bangladesh. Most work has focused on rolling out awareness-raising and training campaigns, involving large numbers of master trainers through face-to-face events and equally using video campaigns (the latter reaching 130,000+ farmer viewers). Monitoring work has allowed capturing FAW population trends and damage; the bulk of farms experience 0-10% yield loss. Institutional change has been pursued, in order to fast-track the registration of different biological control products (e.g., sex pheromone lures, NPV). Agricultural input dealers are farmers' primary point of contact for advice; >1,750 dealers were trained on moral hazards and FAW IPM training. Market impediments, e.g. cold storage capability, have been overcome to promote augmentative biological control.

An educational video is shown that covers multiple facets of FAW integrated pest management, introduces key aspects of the pest ecology and includes a number of farmer testimonials. The video also provides important information on how to deploy pheromone traps, interpret trap readings or conduct field scouting. Emphasis is equally placed on the importance of balanced fertilization, irrigation and good agronomic management.

In the Q&A session, Kris Wyckhuys emphasizes that FAW incidence cannot be readily be translated into yield impact. It is important to emphasize that a 20% incidence of FAW-affected plants does not mean a 20% yield loss. The Q&A session is closed with the LURAS-supported video on FAW identification, scouting and integrated management in Lao PDR.

#### **Panel discussion moderated by Marjon Fredrix**

Q1: How do you deal with farmer training in times of the Covid pandemic?

Wilmar Cuaterno (BPI, Philippines) emphasizes how BPI has historically focused on face-to-face training & it's not easy to switch to online / virtual training approaches. Some training methods lend themselves for face-to-face (in-field) training, while other methods (and topics) can easily be covered through virtual means. Approx. 20% of the FFS content can easily be conveyed through digital media.

Andrew Bartlett (Helvetas, Lao PDR) indicates that there's been limited problems related to Covid-19 in Lao PDR & it did not interfere much with FAW-related training events. Using social media, e.g., through the sharing of video / photos in Whatsapp, has been very effective in supporting action research. Small communities of practice (e.g., 20 people linked on Whatsapp) are suitable to aid farmer learning and advance technology transfer.

### Q2: What do farmers need to manage FAW sustainably?

Kris Wyckhuys (Chrysalis Consulting) emphasizes how FAW -as an invasive pest- represents a new shock and disturbance in Asia's maize farming systems. Farmers are unfamiliar with the pest, alarmed by its voracious feeding and conscious about its potential impacts on revenue (and poverty vulnerability). As a result, their actions are aimed at assessing the importance of FAW-related risks, anticipating the magnitude of pest-induced losses and then ultimately removing this risk. Farmers' decisions are based upon a) knowledge of the pest, b) understanding of ecological processes, c) familiarity with IPM tools and technologies, and d) (perceived) susceptibility of a given crop/cropping system.

As many farmers overestimate the risk of pest-induced losses, future training could involve a participatory assessment of yield loss / economic impacts. Most farmers worldwide know little (or nothing) about natural enemies and are unfamiliar with biological control; hence, it's essential to use FFS to introduce them to biological control. Pesticides are omnipresent in the Southeast Asian countryside, can be easily trialed and are frequently considered as 'medicine'. It is essential to let farmers trial-use biopesticides or biological control methods, and to set up demonstration fields accordingly. In all of the above topics, 'seeing is believing'. Lastly, in order to remove farmers' perceived susceptibility to pest attack, innovative insurance finance and schemes can be deployed. Locally-relevant information needs to be shared among farmers, accompanied by appropriate policies and tailored to different crop typologies. Simple messaging and heuristics are likely to be effective in modifying farmer behavior.

Andrew Bartlett indicates how an education campaign and action research program were rapidly rolled out following FAW invasion. FFS at scale are likely not effective to promote FAW IPM in Lao PDR; maize is largely a transitional crop (experiencing a so-called 'maize boom') and is not used for human food in Lao PDR. Local farmers are likely not interested to invest the necessary time/money in maize pest management. Very simple responses are needed; messages could be refined based upon action research findings. High pest-inflicted losses likely will speed up the transition towards a different crop. There may be opportunities for sweet corn production systems, but not for those growing maize for animal feed.

### Q3: What are gaps in making biological and IPM work for farmers?

Wilma Cuaterno indicates how an inability to institutionalize IPM training programs has caused that many Philippine farmers have lost interest. FFS is participatory, experiential and discovery-based; it is essential to continue promoting this kind of training approach. In the Philippines, biopesticides and biological control agents are often not locally available. There may be opportunities for local (farm-level, cottage-style) production of certain beneficial organisms.

Kris Wyckhuys highlights the enormous potential for biological control, but equally lists a number of gaps to promote different types of biological control and IPM overall. On conservation biological control, more ecological research is needed e.g., to discover and describe locally-occurring natural enemies, and to investigate ways to conserve those organisms. This information needs to be validated on farm, communicated to growers and packaged in such way that farmers can discover such processes by themselves. It is equally important to assess the economics of biological control or to systematically quantify its benefits e.g., in terms of human health. For augmentation biological control, much work waits to be done to fast-track registration of biopesticides, put in place supportive policies and promote the cottage-style

production of natural enemies. In the latter, attention needs to be paid to ensuring quality (e.g., fitness, sex ratio), allowing sufficient access in rural areas (e.g., through cold storage).

Opportunities are highlighted to either push biological control and IPM e.g., through outcome-based rewards, favorable farmer credit schemes or 'polluter pays' policies that punish growers who primarily resort to high-risk pesticides. Conversely, the uptake of biological control can also be demand-driven e.g., with consumers demanding healthy / pesticide-free foods or biodiverse rural settings. In the latter, market forces come into play and can turn favorable for IPM or sustainable crop protection.

### **Take-home messages of webinar #2:**

Critical importance of sound IPM design for FAW prevention and sustainable management: Pyramid-shaped design versus Obelisk, pillar or inverted pyramid shape. It is of crucial importance to deliberately prioritize a range of good IPM practices (cultural, mechanical, biological) before considering chemical pesticide applications. Pesticides are to be promoted as "measure of last resort" instead of a first line of defense (e.g., as being done through insecticide-coated seed treatments).

Enhance farmers' access to cost-efficient and effective biological control options, be it from private and/or public sector or produced by farmers themselves. That includes policy reform and regulatory action to fast-track biological control options (e.g. the Fawligen-SfNPV example from Bangladesh).

Pesticides use as a last resort and in case these are used, ensure elimination of use of HHPs by farmers and prioritizing choice for softer chemicals with low health/environmental impact, which requires regulatory action and collaboration with a range of public and private sector actors. The recently published pesticide risk reduction guidance put out by Paul Jepson et al. (see attached), is useful to consider in this context.

Design of IPM and associated communication and training approaches based on specific needs of target communities and production/farming systems. This can include putting out a mix of simple messages to provision of more intensive training such as Farmers Field Schools, depending on needs-identification of the target communities. The Laos example (as shared by Andrew B.) comes to mind where relatively large scale and input-intensive (e.g. hybrid corn, often already pesticide-coated seeds) commercial corn producers in northern Laos basically are less interested in sustainability issues and do farming for cash income with limited time spend on managing production activities and with an uncertain future of whether this type of export-oriented and unsustainable production systems can or should prevail for much longer. Perhaps reaching such farmers at scale with specific IPM-based instructions through smart use of ICTs and putting out simple messages through social media is much more effective compared to setting up intensive and time-consuming FFS interventions. This in comparison with corn being an integral part of farming systems of smallholders (e.g. as is common in southern Laos) for food security purposes. Targeted IPM education through FFS approaches, for many reasons, would seem much more useful, feasible and beneficial to such a generally poor, less educated target rural community and well worth the investment.

Good IPM decision making by farmers must remain grounded in understanding ecosystems and ecological considerations, requiring good IPM/ecological knowledge. Encouraging farmers to monitor their fields regularly and make well-informed management decisions based on sound agroecosystem analysis remains as important as ever.

Ensure that farmers make smart use of ICT tools, including use of smart phone applications such as social media for information access, sharing experience and building communities of trust (social capital). Ensure that farmers have access to education to master the required digital skills, particularly relevant for older generations of farmers involved in contemporary agriculture in the Asia and Pacific region (e.g. Philippines example).

## **B.3: Webinar #3 (Friday November 6, 2020)**

### **1. FFS curriculum and learning activities, training of trainers**

**Dada Abubakar** summarizes some of the key findings / take-home messages from day #2 and sets the stage for the third session of the FAW webinar.

**Anne-Sophie Poisot (FAO HQ)** then gives a first presentation covering farmer field schools (FFS) and opportunities for education on ecological pest management. FFS embody 'discovery-based learning' with 'the field as the book', and FFS for fall armyworm have now been conducted in 40+ countries. For FAW, FFS are well-suited to promote preventative, sustainable and low-cost measures, but ecosystem-based approaches (e.g., biological control) are more complex. Innovating with farmers is key. FFS ideally are to be blended with other approaches such as plant health rallies, video screenings, mobile messaging, radio. By employing the latter approaches, the reach of training programs can be extended. Insect zoos can help farmers observe who eats whom and convey topics such as food webs or trophic levels; defoliation studies help growers anticipate pest-related risks and yield impacts. Field studies can also involve the evaluation of fertilization schemes, botanical pesticides, intercrop arrangements, push-pull systems. Interestingly, FFS can be used as sentinel sites for FAW surveillance and to further the promotion of FAMEWS.

FAO has developed an FFS guide on FAW integrated management, organized training for 450+ Master trainers, and trained 350,000 farmers on this topic. For existing FFS Facilitators or Master Trainers, short (3-6 day) refresher courses can introduce a range of concepts and FAW-related information. FAW IPM information can equally be integrated in existing FFS on other topics or crops. Covid-19 has accelerated the digitalization of (FFS) extension programs; now, a balance needs to be sought between in-person, field-level learning and the use of ICTs. Anne-Sophie further shares many useful links to the Global FFS platform and training resources.

**Paul Van Mele (Access Agriculture)** gives an inspiring talk on digital technologies (e.g., video) and their integration in farmer training schemes. FFS can only reach a limited number of farmers, often do not reach youth and women, while peer-to-peer transfer of ecological knowledge is often challenging. Access Agriculture develops simple, researched and effective training videos – which lend themselves to repeat viewing, sharing across borders and eventual broadcasting by media houses. Videos can trigger farmer experimentation and local innovation. Access Agriculture has 220+ quality videos in >80 languages, has a video platform, smart projector and digital application; yet, its video platform has been used by >500,000 people globally and more than 3000 organizations have used its videos to train farmers. Overall, Access Agriculture videos have reached more than 60 million farmers.

Farmer-to-farmer educational videos can be used by a range of stakeholders, i.e., farmers, extensionists, researchers and educators. A mobile video platform (accessible through smartphones) can help boost video viewings, coverage and impact. Videos can favor South-South learning and information exchange. A second platform (EcoAgTube) will be launched and specifically cover agro-ecology. Young entrepreneurs are being equipped, coached and trained to become private e-extension experts & potentially can work alongside FFS programs.

### **2. Small group discussions on training needs / opportunities**

**Group 1:** Spokesperson Wilma Cuaterno; Co-moderator Marjon Fredrix

Initial questions: What are training target beneficiaries/communities (stakeholders) in rural areas for which effective FAW management strategies and training programmes need to be designed? What kind of training does each target beneficiary/community need? What training (content and intensity) is needed for a not yet infested area, what for a newly infested/low population area and what for heavily infested area with FAW establishment (immediate and longer term responses)?

**Report:** It is important to provide country-specific information on insecticide resistance management, (pre-existing and evolving) levels of resistance in the invasive FAW population, knowledge of FAW biology and ecology.

**Group 2:** Spokesperson Paul Van Mele; Co-moderator Anne Sophie Poisot

Initial questions: What activities on FAW FFS/extension/communication are planned/ongoing in your countries? What works? What does not work? What additional training resources are needed beyond what you have available already? How does COVID 19 affect hands-on face-to-face training and how does this influence your training strategy/ies? What kind of training/activities are possible in the current context of COVID 19? What additional skills are needed to be a good online facilitator?

**Report:** What activities are presently being undertaken: Initially there was a focus on pesticides in India, but now they are testing Metarhizium, Beauveria (being tested together with private sector), intercrops, pheromone lures, and use of slow-release dispensers for monitoring purposes. There has been lots of awareness-raising, collaboration with many different international institutes & engagement of local experts from across the region. Efforts are also made to establish an early-warning system.

How does Covid-19 situation affect the training: there are many different Whatsapp groups being established with different people, discussing different themes. Social media is very important. Local language is very important & webinars for farmers are being organized (showing pictures of fall armyworm and different developmental stages). Leaflets have been established in the local languages & distributed through different means. WHO has programs on health-related vectors; for these programs, it is important to engage key communities to identify local trainers & thus facilitate training (this avoiding movement of people).

Once FAO FAW videos are translated into local languages and e.g., hosted on the Access Agriculture platform, anyone can freely download the videos. Access Agriculture could also add the local language leaflets or manuals as an additional resource under the FAW videos to help further spread these local language resources.

**Group 3:** Spokesperson Jam Khalid; Co-moderator Kris Wyckhuys

Initial questions: Where there is existing capacity for farmer training, what additional training is needed to prepare facilitators and trainers for effective training interventions on FAW management – long or short? What would the contents, process and duration be of long training programmes be? Short training programmes? What skills and knowledge would facilitators need to assess better what to include in farmer training for it to be more targeted to different scenarios of FAW infestation/establishment?

**Report:** What additional training is needed: knowledge and information-sharing at the country level; several countries have little experience with FAW. Knowledge and information exchange at the country level. Institutional capacity development in areas where FAW has recently been reported. Village-level crash training programs. Integrate FAW management as a cross-cutting in all ongoing FFS/other long-duration training programs.

Contents: Types of ICT tools being used for FAW management, use of ICT tools for facilitators, videos, digital support, reaching farmers' process, FAW resilient practices; processes: early warning, early actions on FAW, FFS, mass-media campaign, awareness-raising, agro-ecological preventative measures, community action, farmer-to-farmer learning, resistant varieties.

Duration: from a few days to 6 months and even a complete year.

Knowledge and skills required: FAW identification, monitoring and reporting, non-formal education skills for adult learning, science by farmers' skills – basic science.

**Group 4:** Spokesperson Vornthalom Chanthavong; Co-moderator Jan Willem Ketelaar

**Initial questions:** How can you mobilize the network of FFS Facilitators and Master Trainers in your countries to support your FAW programmes? National/regional experts? The Global FFS Platform? What mechanisms do you have in place to exchange and share within the Asian FFS IPM network in the current context? Considering that you will have to carry out various tasks relative to FAW management, how can you ensure quality of your FAW training programmes?

**Report:** This report very much pertains to the Lao PDR context. The existing network can be mobilized by working together with government agency and Plant Protection Center of DoA. As regards to (national/regional) experts, we can informally reach out to people whom we know. We can use global platform as a source of information / experience exchange. The Global FFS platform is used as a knowledge bank. Overall, in many activities, the Lao PDR government is the main mediator.

Mechanisms that are currently in place allow for an exchange/sharing of experiences within the Asian FFS IPM network – these include approaches such as ICTs, social media, online meetings. Applications such as Line and WhatsApp are used to keep in touch, exchange and share information, while updates and follow-up information is sometimes provided through email.

Starting from giving the refresher training to existing network; use ToT to train new trainers in area where there is no network. Move them to support farmers on FAW management, using FFS training models. In order to ensure quality FAW training programs, baseline surveys and assessments should be done; it is equally important to conduct field monitoring. Refresher ToTs and ToT on sustainable FAW management should be conducted for existing IPM trainers and new IPM trainer; the existing IPM network in Lao PDR can contribute to such initiatives.

**Presentation by MARD-PPD (Vietnam) by Dr. Bui Xuan Phong,** covering experiences with the development of the sweet-and-sour bait traps. Use molasses from sugarcane (40%), vinegar (40%), alcohol (10%) and water (10%), mix ingredients and keep for incubation in a large plastic bottle or other device. Once the mixture is fragrant, it can be used in the field. Poisonous baits can be prepared by mixing 5 ml of pesticides with 1.5 l of sweet-and-sour bait; pieces of cloth can then be soaked with this bait and used in plastic bottles with a large opening. Most effective is 40-60 traps are placed per hectare; traps are deployed at maize canopy height. Traps can be used throughout cropping cycle, placed in the field before sowing maize in the field. When comparing molasses traps with pheromone traps, the efficacy of pheromone trap is higher but its price is high / restricted availability in Vietnam. Main advantage of molasses bait trap is that individual farmers can develop/use it throughout the country. At the early-season maize, molasses bait traps can be used – in later developmental stages, parasitoids can be used and eventually insecticides can be applied (in infestation hotspots or at outbreak levels).

### 3. Future development needs & wrap-up

**Dada Abubakar shares links** to further FFS training materials & guidance on FAW management.

**Anne-Sophie provides a recap on developing training plans** on sustainable fall armyworm management. Using menti.com a number of questions were presented to the audience.

Overall goal of FAW training plans (menti responses): promote IPM, innovation, farmer empowerment, prevent pesticide abuse, eco-friendly management, agro-ecology, provide early-warning, knowledge sharing, education, bolster training capacity. We need to promote agro-ecosystem based approaches, preventative measures and biological control with the ultimate goal of reducing FAW pressure on crop yields, farmer livelihoods. How can a range of stakeholders work together to promote this over-arching objective. We need to keep in consider the IPM pyramid. In the bottom of the pyramid, we need to include 'avoidance' and 'preventative approaches', 'cultural control', 'mechanical control', 'agro-ecological control', 'landscape-level interactions' and 'biological control'. Middle section is 'detection', 'sampling', 'monitoring systems'; the top (pesticides, economic thresholds) should receive least attention the measure of last resort.

Country-level formulation of IPM packages (menti responses): In most countries, there's an upside-down pyramid in which pesticide use prevails. This emphasizes the importance of disseminating the approaches that are present at the bottom of the IPM pyramid. Enhance and support access to biological control – conserve already existing NEs, explore/tap the potential of biological control (e.g., production and release of entomopathogens), increase access to biological control (commercial, government-led production and release, farm-level / cottage-industry production), fast-track registration of biopesticides and other biologicals. Fast-track process for NPV in Bangladesh (as facilitated through CIMMYT) is an excellent example. This should receive serious policy attention at the national / regional level.

It is crucial to emphasize that pesticides are to be used as a last resort. If pesticides are used, avoid HHPs, favor low-tox and effective pesticides compatible with IPM. Paul Jepson's and FAO's technical working group on insecticide use has develop an excellent guide (as published in The Lancet) on what pesticides are most compatible. Seed coating with Metarhizium are very interesting and are being pursued in Thailand. Some stakeholders are interested in the use of insecticide-coated seeds e.g., Fortenza Duo, but one cannot forget that those contain neonicotinoids such as thiamethoxam – products that are controversial for their negative impact on pollinators (and which, consequently, are banned in the EU).

Fine-tune options using action research; local adaptations, what works/does not work, participatory action researchers, FFS as a jumping board. Importance to assess context and farmer needs. Is maize important in farming systems, how much time do farmers want to spend learning on maize, what do farmers need to know/do? A suitable example here is northern vs. southern Laos.

Suit learning objectives & training modalities to context. Instant messaging? Online learning and information exchange? Action research? Season-long FFS. Sometimes simple messages might be most suited; define them through action research processes & set up peer groups using social media, ensure support by technicians. Build skills on digital facilitation and learning – for both facilitators and farmers.

What questions to ask to assess needs of different farmers & select best training modalities. What is the level of infestation; can farmer recognize FAW / basic identification skills; identify good insects through insect zoo; how old are farmers and do they have access to digital tools; gauge farmers' basic agro-ecological knowledge; good sponsors need to be identified / also based upon the area coverage of maize/sorghum; how many farmers do we want to reach?

Consider Covid context; design training of facilitators courses based on above FFS; community mobilization for FAW management – active monitoring role of community, optimizing biocontrol and IPM, linking with PP & research; Networking is key.

Create an enabling environment for training. Advocacy at policy level to ensure funds/support to training, investing in farmers and ecosystems. Regulatory frameworks for biological control, biopesticides, assessment and registration of IPM-compatible insecticides and biological control (e.g., Bangladesh); Policy support and interest for action research and participatory innovations with farmers.

**Closing remarks by Yubak GC:** Various ways are available to manage FAW, but the pest has been gaining pest status in several countries. FAW affects both quantity and quality of maize. Impacts go from negligible to significant (~ 40%) in certain countries. Regional TCP and country-specific TCPs are being rolled out against FAW in the Asia-Pacific region, building on a (FAO-managed) workshop in Bangkok in early 2019. ASEAN FAW action plan is being built to help respond to the recent FAW invasion. Throughout the 3-day program, all sessions were focused on IPM, biological control and capacity building. Excellent coordination and management of the different sessions. Very good to learn experiences from different countries. Objectives of this webinar are well-met. Panel discussions helped enlighten some FAW IPM implementation challenges. Covid has a grave impact on the agriculture sector; monitoring and management of FAW are consequently difficult during these times. Ensure food security during these challenging times. Thanks to all participants, speakers, panelists, moderators and co-organizers. Sincere thanks to Thai Education Foundation colleagues, including Marut, Jan Willem and colleagues.

**Marut Jatiket equally thanks FAO** for technical support and funding for this important event; emphasizes how up to 71 participants took part in the webinar at a given stage. For all sessions, the majority of participants stayed until the end.

# **Annex I: CONCEPT NOTE: Regional Training Workshop for Farmer Field School facilitators on sustainable management of Fall Armyworm: IPM, Biocontrol and Farmer Field Schools**

## **Background**

The Fall Armyworm (*Spodoptera frugiperda* or FAW) was first confirmed outside of its native Americas in Africa in early 2016. Since then it has rapidly spread across Sub-Saharan Africa, infesting tens of millions of hectares of maize, sorghum and millet. In July 2018 it was confirmed in Yemen and India and has since then spread quickly in the Asian region. As of October 2019, presence of FAW was confirmed in most of the Asian countries, including Bangladesh, China, Indonesia, India, Japan, Laos PDR, Malaysia, Myanmar, Nepal, south Korea, Sri Lanka, Vietnam, Cambodia and the Philippines. In early 2020 FAW was also confirmed present in Australia. FAW can cause significant yield loss to maize and other crops if not managed well or in the absence of natural control.

FAO organized an [Experts Meeting](#) in July 2017 in Ghana, bringing experts from Brazil, Mexico, USA to present lessons learned from the Americas and work with African colleagues to identify priorities and develop a partnership. Out of this meeting, twelve Technical Working Groups were formed that have helped guide the global FAW Programme.

FAO has developed a robust [FAW Programme for Action](#), in collaboration with many partners and developed a [Framework for Partnership](#). In late 2019 the FAW Global Action Initiative was launched at FAO-HQ in Rome with details published here: <http://www.fao.org/news/story/en/item/1253916/icode/>

Many of the relevant FAW resource documents are available of [FAO's FAW website](#).

In early August 2020 ASEAN approved a FAW action plan which spells out priority actions for FAW management to be implemented in the ASEAN region. The ASEAN Action Plan on Fall Army Worm is available at: <http://exchange.growasia.org/asean-action-plan-fall-armyworm-control>

As FAW continues to spread, FAO is poised to help member countries be aware of the threat, take action to monitor arrival, take early action, learn lessons from other regions, further strengthen the community of international experts, develop regional, national plans' of action, and identify the current knowledge gaps to identify research priorities and work closely with farmers and their organizations in responding.

An International Conference on FAW in Asia took to take place in Bangkok, Thailand in March 2019. FAO brought together relevant scientists and practitioners to share knowledge and experiences and help the region prepare for the continued spread of FAW in Asia. See:

<http://www.fao.org/3/ca4603en/ca4603en.pdf>

FAO supports several TCPs at country and regional level in the Asian countries to support sustainable management. One important component of FAO's strategy is the training of farmers on FAW IPM using Farmer Field School approaches for small country teams of Asian countries that face the FAW problem.

## **Purpose**

The regional training aims to:

- Improve knowledge and skills on Integrated Pest Management for Fall Armyworm;
- Improve knowledge and skills on biocontrol options for FAW;
- Get familiar with FAW monitoring tools and protocols, including FAMEWS;
- Fine-tune the Farmer Field School curricula by integrating FAW IPM and biocontrol, including agroecological approaches;
- Develop and share national action plans for fortifying refresher training of trainer, farmers field schools and other short hands-on learning courses on FAW.

## **Expected Outcomes**

- Country teams, field school facilitators and researchers strengthen knowledge and skills on sustainable FAW management in Asia, including IPM, agroecological approaches, biological control and use of monitoring tools and protocols, including FAMEWS
- Country teams exchange information and experiences on FAW management so far in the region and elsewhere
- Country teams share their plans for farmer training on FAW management, including FFS and where relevant short trainings that use hands-on approaches, and link them to ongoing (FAO) projects and programmes

## **Training Approach and Methodology**

The regional training was originally foreseen to be held in Thailand. Due to travel restrictions still in place related to the ongoing Covid-19 pandemic the training will instead be virtually delivered through 3 webinar sessions, with each session lasting for 3 hours. The agenda for each of the sessions will consist of short presentations and followed by interactive Q &A sessions. There will be ample scope for country delegations to share experiences and resources as well as present workplans.

## **Target Participants**

The target participants, approximately 50 maximum per session, include country teams from South Asia and Southeast Asian countries where FAW is already present and with ongoing FFS activities. Participants are expected to take part in the entire webinar series, consisting of 3 sessions.

## **Presenters**

- National government representatives responsible for FAW management.
- Experienced IPM FFS facilitators and FAW applied researcher/R&D representative.
- FAO staff/consultants and resource persons with relevant FAW experience/work mandate

### **Moderator team**

The webinar sessions will be facilitated by a small team of moderators, including one lead moderator with longstanding experiences on IPM and FFS in the region, to be supported by other facilitators and resource persons from the Asia region with experiences on biological control, IPM and FFS. Moderators assigned to facilitate each session will facilitate presentation, discussion and Q&A. The report will be compiled by the rapporteur with inputs from the session moderator team leader.

### **Country Team preparations and assignments:**

FAO will invite the national government representative a month prior to the start of the first webinar session with a country report questionnaire form to be filled out and submitted to the Lead moderator prior to start of the webinar, preferably ***not later than 30 September***. The country report questionnaire responses will be used as input to development of the webinar 2<sup>nd</sup> and 3<sup>rd</sup> sessions, the country presentation section on FAW management and FFS innovation in particular. The country report questionnaires will be also be used for development of the webinar report to be shared with all participants after conclusion of the entire webinar series event. In preparation and in follow up to the third and last session of this webinar series country teams will be expected to work in country teams to develop and share FFS curriculum, training outline and activity workplans.

### **Tentative Webinar Programme:**

<b>Thursday, October 29, 2020</b> <b>13:30 – 14:30: Introduction of FAW Regional Webinars</b> <ul style="list-style-type: none"><li>- Short Opening Statements (5 mins., total)</li> <li>- Overview/regional status report of FAW, IPM and Biological Control in Asia (15 mins.)</li> <li>- FAO FAW Global action plan with focus on Asia (15 mins.)</li> <li>- Introduction to FAMEWS (10 mins.)</li> <li>- Introduction to ASEAN FAW Action Plan (10 mins.)</li></ul> <b>14:30 – 15:30 Status and Innovations in FAW IPM and Biological Control in Asia: Development of IPM strategy and use of Bio Control for FAW</b> <ul style="list-style-type: none"><li>- Experiences from Philippines: (15-20 mins.)</li></ul>	<b>Moderator: Kris Wyckhuys</b> Yubak Dhoj GC/FAO, Marut Jatiket/ Thai Education Foundation  Kris Wyckhuys, Chrysalis  Buyung Hadi/ FAO-HQ  Jean Rwaburindi/ FAO-HQ  Bui Xuan Phong, VN/MARD-PPD  <b>Moderator: Kris Wyckhuys</b>  Ms. Wilma Cuaterno, BPI Crop Protection, John Paul D. Maminta, CPMD-Bureau of Plant Industry, Ivan
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<ul style="list-style-type: none"> <li>- Experiences from India: (15-20 mins.)</li> <li>- Experiences from China: IPM-compatible technologies and delivery systems (15-20 mins.)</li> </ul> <p><b>15:30 – 15:45: Summary of the Grow Asia/CABI Webinar series on FAW biological control</b></p> <p><b>15:45 – 16:00: Q&amp;A and ways forward</b></p>	<p>James S. Pintokasan, Regulatory Division, DA-RFO 12</p> <p>N. Bakthavatsalam, ICAR – Bangalore National Bureau of Agric. Insect Resources</p> <p>Wang Zhenying, Chinese Academy of Agricultural Sciences</p> <p>Allison Watson/ Grow Asia, Malvika Chaudhary/ CABI</p>
<p><b>Tuesday, November 3, 2020</b></p> <p><b>13.30 – 13.45 Recap and Session Introduction: Getting strategies out in the field and Used by Farmers</b></p> <p><b>13:45 -15:00: Experiences from selected Asian countries on field implementation of national FAW-IPM/Bio control R&amp;D and Training programmes</b></p> <ul style="list-style-type: none"> <li>- <b>AP Region:</b> Summary on status of FAW, national policies, management efforts, innovations, capacity building/training, implementation challenges (<i>15 minutes summary presentation based on submissions by countries of responses to baseline study/questionnaire</i>)</li> <li>- <b>Thailand:</b> FAW IPM management strategies, policies, video on biocontrol efforts, rearing process and results to date (Presentation &amp; video, 20 minutes total)</li> <li>- <b>Lao PDR:</b> FAW monitoring, management advice, biocontrol and farmer training (<i>video and short presentation, 15 minutes total</i>)</li> <li>- <b>Bangladesh:</b> FAW monitoring, management and farmer advice/training (<i>video, 10 minutes</i>)</li> <li>- <u>Q&amp;A (15 minutes)</u></li> </ul> <p><b>15:00 – 16:15: Panel Discussion: Getting the FAW Management strategies out to the field With discussion focused on the following themes/questions:</b></p>	<p><b>Moderator: Marjon Fredrix/Jan Willem Ketelaar</b></p> <p><b>Moderator: Jan Willem Ketelaar</b></p> <p>Kris Wyckhuys, Chrysalis</p> <p><b>Thailand:</b> by Woranad Khokyen, Siros, Suwanmanee, Sunisa Pewrumpai, DoAE-Thailand</p> <p><b>Laos:</b> Dr. Pheophanh (NAFRI)</p> <p><b>Bangladesh:</b> Timothy Joseph (CIMMYT-Bangladesh)</p> <p><b>Moderator: Marjon Fredrix</b> Panel members: TBC</p>

<ul style="list-style-type: none"> <li>• Training in times of Covid: online and field-based learning in FFS. Experiences, challenges, finding the right kind of mix</li> <li>• What do farmers need to manage FAW? Differences between place of maize in farming system: commercial (contract) growing of maize, maize for food production? Implications for training strategies?</li> <li>• Gaps related to making biocontrol work for farmers? This could include issues of availability, access, reliability, efficacy, costs, etc)</li> </ul> <p><b>16:15 – 16:30: Session Conclusion/Wrap Up and getting ready for 3<sup>rd</sup> and final webinar session #3</b></p>	
<p><b>Friday, November 6, 2020</b></p> <p><b>13:30 – 16:00: FFS curriculum and learning activities, training of trainers curriculum</b></p> <ul style="list-style-type: none"> <li>- Introduction to session (10 mins.)</li> <li>- Farmer Field School and education for ecological FAW management with farmers (15 mins.) Q&amp;A (5 mins.)</li> <li>- Digital technologies and their potential integration in farmer training schemes (15 mins.) Q&amp;A (5 mins.)</li> </ul> <p>Break out groups (15 mins.)</p> <p>Plenary Groups' Report (15 mins.)</p> <ul style="list-style-type: none"> <li>- Introduction to available guidance and FFS materials on FAW at global and regional levels and exploring what more is needed (5 mins.)</li> <li>- Summary (5 mins.)</li> </ul> <p><b>16:00 – 16:30: Future development needs and sharing country plan</b></p> <ul style="list-style-type: none"> <li>- Countries sharing of national FFS action plans for FAW</li> <li>- Future development needs</li> </ul>	<p><b>Moderator: Dada Abubakar</b></p> <p>Anne Sophie Poisot, FAO</p> <p>Paul Van Mele, Access Agriculture</p> <p><b>Moderator: Anne Sophie Poisot/</b></p>

## Annex II: List of Participants

No.	First Name	Last Name	Email	Organization	Job Title	Sector	Country
1	Mike	Furlong	m.furlong@uq.edu.au	University of Queensland	Professor	Academe / Education	Australia
2	Khadeja	Kobra	Khadeja.Kobra@fao.org	FAOBD	Programme Support Assistant	International Organization	Bangladesh
3	Anil kumar	Das	anil.das@fao.org	FAO Bangladesh	National Consultant (Programme)	International Organization	Bangladesh
4	Nur Ahamed	Khondaker	nur.khondaker@fao.org	FAO Bangladesh	Assistant FAO Representative (Programme)	International Organization	Bangladesh
5	Md Fuad	Mondal	mondalmf.entom@sau.ac.bd	FAO, Bangladesh	National Pest Management Expert	International Organization	Bangladesh
6	Sonam	Dorji N	sdorjin@moaf.gov.bt	BAFRA, MoAF	Sr RQO	Governmental Organization	Bhutan
7	Ugyen	Dema	demaugyen258@gmail.com	Department of Agriculture, Ministry of Agriculture and Forest	Sr. Plant Protection	Governmental Organization	Bhutan
8	Sangay	Chophel	sangaychophel1@moaf.gov.bt	National Plant Protection Centre, Department of Agriculture	Sr. Plant Protection Supervisor	Governmental Organization	Bhutan
9	Rup Narayan	Suberi	rupsbedinarayan@gmail.com	National Plant Protection Centre, Ministry of Agriculture and Forests	Plant Protection Officer	Governmental Organization	Bhutan
10	Tshomo	'-	tshomo@moaf.gov.bt	National Plant Protection Centre	Sr. Plant Protection Officer	Governmental Organization	Bhutan

No.	First Name	Last Name	Email	Organization	Job Title	Sector	Country
11	Oeurn	Samoul	oeurn.samoul@gmail.com	Department of Plant Protection Sanitary and Phytosanitary	Technical Officer	Governmental Organization	Cambodia
12	Chhe	Virak	chhe.virak@gmail.com	Srer Khmer	Agricultural Field Officer	Non - Governmental Organization	Cambodia
13	Vireak	Veth	vethvireak@yahoo.com	Agrisud international	AC	Non - Governmental Organization	Cambodia
14	CHINH	Pheareak	chinhpheareak@gmail.com	AGRISUD Cambodia	Deputy Project Manager	Non - Governmental Organization	Cambodia
15	TI	NIT	nittifc1@gmail.com	GDA	Pest diagnostic office	Governmental Organization	Cambodia
16	Feng	Zhang	f.zhang@cabi.org	CABI	Regional Director	International Organization	China
17	Nilesh	Chand	nachand@baf.com.fj	BAF	CPPO	Governmental Organization	Fiji
18	Satya	Wardhana	swardhana@provivi.com	Provivi	Business Development	Non - Governmental Organization	Indonesia
19	Arief Lukman	Hakim	arieflh@gmail.com	FIELD Indonesia	Project Manager	Non - Governmental Organization	Indonesia
20	Jaba	Jagdish	j.jagdish@cgiar.org	CGIAR			India
21	Sharabnabasappa	Deshmukh	sharanu.deshmukh@gmail.com	University of Agricultural and Horticultural Sciences Shivamogga	Assistant Professor	Governmental Organization	India
22	Uday	Belsare	belsaress@gmail.com	State govt.	Agriculture	Governmental Organization	India

No.	First Name	Last Name	Email	Organization	Job Title	Sector	Country
23	SEKHAR	JC	javajics@gmail.com	ICAR	PRINCIPAL SCIENTIST & I/C	Governmental Organization	India
24	Richa	Varshney	richavarshney84@gmail.com	ICAR-NBAIR Bengaluru	Scientist	Governmental Organization	India
25	Mamta	Sharma	Mamta.sharma@cgiar.org	ICRISAT	Principle Scientist And Theme Leader Integrated Crop Management	International Organization	India
26	Maged	Elkahky	maged.elkahky@fao.org	FAO	Agricultural officer	International Organization	Italy
27	Gaku	AKIDUKI	akiduki@affrc.go.jp	Kyushu Okinawa Agricultural Research Center, NARO	Principal Researcher	Governmental Organization	Japan
28	Jihad	Haddadin	jihadipm@yahoo.com	NARC	Director of plant protection directorate	Governmental Organization	Jordan
29	Khounthanong	Vanthanouvong	picprojectmanager@adralaos.org	ADRA	project manager	Non - Governmental Organization	Lao PDR
30	Soysouvanh	Pheophanh	pheophanhs@gmail.com	Department of Agriculture, MAF	Entomologist	Governmental Organization	Lao PDR
31	Vornthalom	Chanthavong	Chanthavong.Vornthalom@gmail.com	FAO	Country Project Manager	International Organization	Lao PDR
32	MUHAMMAD ZAIM BIN	RAPIDI	zaimrpd@gmail.com	DEPARTMENT OF AGRICULTURE MALAYSIA	AGRICULTURE OFFICER	Governmental Organization	Malaysia
33	LAILATUL JUMAIYAH	SALEH HUDDIN	lailasaleh@gmail.com	Department of Agriculture Malaysia	Agriculture Officer	Governmental Organization	Malaysia
34	Justina	Rolland	Justina.Rolland@sabah.gov.my	Department of Agriculture Sabah, Malaysia	Research Officer	Governmental Organization	Malaysia

No.	First Name	Last Name	Email	Organization	Job Title	Sector	Country
35	Noorohaida	Mohd Yunus	qistinahaida@gmail.com	Department of Agriculture	Assistant Agriculture Officer	Governmental Organization	Malaysia
36	Nor	Faezah	eizaxl11@gmail.com	department of agriculture	.	Governmental Organization	Malaysia
37	MUHAIDA	MOHAMMAD	muhaida12@gmail.com	Department of Agriculture	Agriculture Officer	Governmental Organization	Malaysia
38	Nur Fatihin	Zulkefli	nur.fatihin.zulkefli@gmail.com	Department Of Agriculture	Agriculture Officer	Governmental Organization	Malaysia
39	Nur Zaitasha	Mahmudin	nztasha@gmail.com	Department of Agriculture	Agriculture Officer	Governmental Organization	Malaysia
40	Ni Ni	Htain	ninihtain@gmail.com	Plant Protection Division	Researcher	Governmental Organization	Myanmar
41	Aung Ko	Win	Aung.Win@fao.org	Food and Agriculture Organization	Agriculture Specialist	International Organization	Myanmar
42	Sai Kham	Thi	sai.khamkham.thi@gmail.com	The Johanniter International Assistance	Project Coordinator	Non - Governmental Organization	Myanmar
43	San San	Htwe	San.Htwe@fao.org	FAO	Project Coordinator	Others (Please specify in comment section below)	Myanmar
44	Mahesh Chandra	Acharya	msggacharya@gmail.com	Plant Quarantine and Pesticide Management Center	Senior Plant Protection Officer	Governmental Organization	Nepal
45	Mahesh	Timilsina	maheshtimilsina7@gmail.com	Plant Quarantine and Pesticide Management Center	Plant Protection Officer	Governmental Organization	Nepal
46	LALIT	SAH	lpsah@ideglobal.org	iDE Nepal	Senior Technical Specialist	International Organization	Nepal
47	Ajaya	Bajracharya	ajayabajracharya@yahoo.com	Nepal Agricultural Research Council	Senior Scientist	Governmental Organization	Nepal

No.	First Name	Last Name	Email	Organization	Job Title	Sector	Country
48	Madhav	Bhatta	madhavppo@gmail.com	Ministry of agriculture and livestock Development	Plant protection officer	Governmental Organization	Nepal
49	Toya	Joshi	joshitoyanath@gmail.com	Ministry of Agriculture and Livestock Development	Plant Protection Officer	Governmental Organization	Nepal
50	Sunil	Aryal	sunilaryal2005@gmail.com	NERC, NARC	Senior Scientist	Governmental Organization	Nepal
51	Ramkrishna	Subedi	rksubediipm@gmail.com	Plant Quarantine and Pesticide Management Centre	Senior Plant Protection Officer	Governmental Organization	Nepal
52	Sahadev Prasad	Humagain	sphumagain2014@gmail.com	Plant Quarantine and Pesticide Management Center	Chief	Governmental Organization	Nepal
53	Sundar	Tiwari	tiwarisundar1979@gmail.com	Agriculture and Forestry University Nepal	Associate Professor	Academe / Education	Nepal
54	Ghanashyam	Bhandari	ghanashyam.bhandari1978@gmail.com	National Maize Research Program/NARC	Scientist	Governmental Organization	Nepal
55	Kiran	Ghimire	kiran.ghimire17@gmail.com	Plant Quarantine and Pesticide Management Centre	Plant Protection Officer	Governmental Organization	Nepal
56	Abdulmajid	Mahmoud	mahmoudabdulmajid60@gmail.com	DHCBI	Livelihood Officer	Non - Governmental Organization	Nigeria
57	Umar	Mohammed Bukar	bbusami@gmail.com	DAMNAISH HUMAN CAPACITY BUILDING INITIATIVES	AGRONOMY OFFICER	Non - Governmental Organization	Nigeria
58	Muhammad	Ramzan	chohanramzan@gmail.com	FAO	Farmer Field Facilitator	International Organization	Pakistan

No.	First Name	Last Name	Email	Organization	Job Title	Sector	Country
59	Jam Ghulam	Mustafa Sahto	gmustafajam@gmail.com	University of karachi	Assist. Prof.	Governmental Organization	Pakistan
60	Jam	Khalid	Khalidjam@hotmail.com	Smallholders Pakistan	Independent Consultant	Non - Governmental Organization	Pakistan
61	Miriam	Mondia	mirriam.mondia@fao.org	FAO-PNG	Head of Programme	International Organization	Papua New Guinea
62	Nigel	Baro	nalchinbaro@gmail.com	FAO-PNG	Programme Officer	International Organization	Papua New Guinea
63	Jacqueline Nakesai	Amos	Jacqueline.Amos@fao.org	FAO PNG	National Programme Clerk	International Organization	Papua New Guinea
64	June	Bowoku	june.bowoku@fao.org	FAO-PNG	Programme Clerk	International Organization	Papua New Guinea
65	Jerry	Requillo	jerry@adra.ph	ADRA Philippines	Program Manager	Non - Governmental Organization	Philippines
66	Jasmine	Magtibay	Jasmine.Magtibay@fao.org	FAOPH	Programme Assistant	International Organization	Philippines
67	Mario	Corado	mario.corado@fao.org	Food and Agriculture Organization	IPM Training Facilitator	International Organization	Philippines
68	Alexander	von Hildebrand	alexvonhil@gmail.com	AAA	Senior Advisor Environment and Health	International Organization	Portugal
69	Abha	Mishra	abhamishra@ait.asia	Asian Institute of Technology	Director	Academe / Education	Thailand
70	Pruetthichat	Punyawattoe	pruetthichat@yahoo.com	Thailand, DOA	Researcher	Governmental Organization	Thailand
71	Nutpachara	Theanworrakant	kosirika@gmail.com	Maejo University	Lecturer	Governmental Organization	Thailand

No.	First Name	Last Name	Email	Organization	Job Title	Sector	Country
72	Charuwat	Taekul	charuwatt@gmail.com	Department of Agriculture	Entomologist, Senior Professional Level	Governmental Organization	Thailand
73	Patchareewan	Chongchitmat e	patchareewanc@hotmail.com	Department of Agriculture	Entomologist	Governmental Organization	Thailand
74	Payorm	Cobelli	payormsri@gmail.com	Rice Department, Thailand	Director of Rice Protection Research Group	Governmental Organization	Thailand
75	Jenny	Manprasong	nantanan215215@gmail.com	NGO	Staff	Non - Governmental Organization	Thailand
76	Nachanan	Wong	cyndy@sarah-org.com	Thai Education Foundation	Intern	Governmental Organization	Thailand
77	Parika	Maneeprem	parika1119@gmail.com	Thai Education Foundation	Staff	Non - Governmental Organization	Thailand
78	Manop	Saipheth	saipheth_manop@hotmail.com	TEF	Facilitator	Non - Governmental Organization	Thailand
79	SOMKHIT	SENGSAY	somkhitsengsay@hotmail.com	Plant Protection Center, Department of Agriculture	Head of Entomology Laboratory	Governmental Organization	Thailand
80	Thanaporn	Monga	thanaporn@1-to-all.com	Zoom	Zoom Technician	Governmental Organization	Thailand
81	Paul	Mutungi	paul.mutungi@fao.org	Food and Agriculture Organization of the United Nations	Regional field school support officer	International Organization	United States of America
82	Tran	Thi Thu Phuong	thuphuonghau1@gmail.com	Vietnam National University of Agriculture	Researcher	Academe / Education	Viet Nam

No.	First Name	Last Name	Email	Organization	Job Title	Sector	Country
83	DUNG	NGO	ngotienungffs@gmail.com	Center for Initiatives on Community Empowerment & Rural Development (ICERD)	Plant Protection	Civil Society Organization	Viet Nam
Presenters/ Moderators							
1	Yubak	GC	Yubak.GC@fao.org	FAO/ RAP			
2	Marut	Jatiket	marutj@thaied.org	TEF			
3	Hadi	Buyung	Buyung.Hadi@fao.org	FAO/ HQ			
4	Jean Claude	Rwaburindi	rwaclaud@yahoo.fr	FAO/ HQ			
5	Kris	Wyckhuys	kagwyckhuys@gmail.com	Kris Chrysalis			
6	Alison	Watson	alisonwatsonnz@gmail.com	Grow Asia			
7	Malvika	Chaudhary	m.chaudhary@cabi.org	CABi			
8	Bui Xuan	Phong	phongbx.bvtv@mard.gov.vn	VN/MARD-PPD			
9	Zhenying	Wang	wangzy61@163.com	Chinese Academy of Agricultural Sciences			
10	N	Bakthavatsalam	directornbai@gmail.com	Bangalore National Bureau of Agric. Insect Resources			
11	Wilma	Cuaterno	cuaternowilma@gmail.com	BPI Crop Protection			
12	Ivan James S.	Pintokasan	ivanjamespintokasan@gmail.com	Regulatory Division, DA-RFO 12			
13	John Paul D.	Maminta	jpdmaminta@gmail.com	CPMD-Bureau of Plant Industry			
14	Jan Willem	Ketelaar	jwkipm@yahoo.com	TEF Consultant			
15	Sunisa	Pewrumpai	s.pewrumpai@gmail.com	DOAE Thailand			
16	Siros	Suwanmanee	tam_hma@hotmail.com	DOAE Thailand			
17	Woranad	Khokyen	woranadk88@gmail.com	DOAE Thailand			
18	Pheophanh	Soysomvanh	pheophanhs@gmail.com	NAFRI, Lao PDR			
19	Timothy Joseph	KRUPNIK	t.krupnik@cgiar.org	CIMMYT, Bangladesh			

No.	First Name	Last Name	Email	Organization	Job Title	Sector	Country
20	Andrew	Bartlett	Andrew.Bartlett@helvetas.org	Helvetas, Lao PDR			
21	CHINH	Pheareak	chinhpheareak@gmail.com	Srer Khmer			
22	Marjon	Fredrix	marjon.fredrix@gmail.com	TEF Consultant			
23	Dada	Abubakar	alm_abubakar@yahoo.com	TEF Consultant			
24	Annie Sophie	Poisot	annesophie.poisot@fao.org	FAO/ HQ			
25	Paul Van	Mele	paul@agroinsight.com	Access Agriculture			

## Annex III: Feedback from participants

1. Overall, how would you rate the contents of the program?
  - a. Very relevant to the management of FAW situations in the regions (56.25%)
  - b. Is helpful to improve management of FAW situations in the regions (43.75%)
  - c. Already know (0.00%)
  - d. Not so much relevant (0.00%)
  
2. How relevant has the webinar been to help develop, revise, or update the national FAW action plan?
  - a. Very relevant (68.75%)
  - b. Somewhat relevant (32.25%)
  - c. Not relevant (0.00%)
  - d. Other (0.00%)
  
3. What session of the programme that you like?
  - a. 1<sup>st</sup> session (56.25%)
  - b. 2<sup>nd</sup> session (31.25%)
  - c. 3<sup>rd</sup> session (43.75%)
  - d. None (6.25%)
  
4. What were 3 key 'take-home messages' for you - from the FAW webinar“?
  - Community management, participation and discussion
  - Capacity building, Biological control and Institutionalization
  - IPM is important to reduce pesticide, Fitness of Biocontrol agents can be enhanced by agroecological methods, FAW management should be conducted following IPM pyramids
  - Adoption of IPM
  - Evaluate the situation, build IPM program, keep update and connected with network programs
  - FFS is very probably the best approach to increase informed decision making amongst farmers
  - Understanding agro-ecology is the most effective to manage emerging pests rather than mere reliance on conventional pest control strategies 2) COVID-19 calls for mixed messaging platforms to enable farmers to make informed decisions; 3) effective management of pests such as FAW calls for active involvement of all stakeholders
  - IPM is a pyramid; fast-track registration of biological control / biopesticides; insecticide seed treatment does not belong in IPM toolbox
  - FFS, BIO AGENTS

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5. Who can benefit most from this webinar programme?
  - a. National FAW Focal Points (12.50%)
  - b. Senior Policy Makers (0.00%)
  - c. Research and Development Practitioners (37.50%)
  - d. Master trainers/ FFS Facilitators (31.25%)
  - e. Extension agents (New to FFS) (12.50%)
  - f. All of the above (56.25%)
  - g. Others (6.25%)  
Organizers too
  
6. How was the online technology help you better?
  - h. Very helpful to learn and share from wider audiences (62.50%)

- i. Somewhat helpful to learn and share (25.00%)
- j. Having difficulty using technology (12.50%)
- k. None (0.00%)

7. How would you rate the organization of the webinar?

- a. Very effective (62.5%)
- b. About right (31.25%)
- c. Session is too long (6.25%)
- d. Too many technical problem (0.00%)
- e. Others (0.00%)

8. What problems did you encountered?

- a. Registration (18.75%)
- b. Links to join the program (18.75%)
- c. Communication with admin staff (12.50%)
- d. None (25%)
- e. Others (43.75%):

Language,

Internet connection (4),

Access to information about the holding of webinar

The first session remained very difficult for me, response from organizer was so late even after repeated request with the problem, I had to miss the program.

9. What information would you like to receive from us?

- Bio-control
- FAW related webinar series, publications, connection with experts
- More update on IPM technology
- All presentations (2)
- Latest Technology Development
- FFS links to other sectors
- Links to relevant video materials and factsheets
- FFS training curricular

## **Annex IV: Summary of National baseline studies for Fall Armyworm (FAW) control (November 2020)**

Country-level questionnaires were compiled on October 29 2020, and included responses to surveys sent out in April 2020 and follow-up requests made in early October 2020 (the latter included an additional set of questions that specifically pertained to the upcoming FAW webinar series). Surveys were sent out through different channels, covering all countries within the Asia-Pacific region. Responses were received from a total of 12 countries, with full responses from five different countries (i.e., Thailand, Philippines, Myanmar, Nepal and Cambodia).

### **Part I.1 – National level coordination**

Most countries (i.e., 8/12) reported the presence of a national Task Force for fall armyworm. So far, no task force has been established in Bhutan and PNG, while no answers were received from Cambodia and Lao PDR. Clear terms of reference (TORs) were available for 4 out of 12 countries. The level of comprehensiveness of TORs for such task force varied considerably between countries, with a detailed description of its purpose and focus in Thailand, Philippines or Nepal, and a far more succinct description e.g., in Myanmar. Several national task forces covered FAW surveillance, spread containment and management, capacity building and skill development, farmer training and technology transfer.

Nine countries elaborated on the exact institutional composition of the FAW Task Force. Countries such as Nepal described a hierarchical structure – comprising a high-level taskforce, technical working groups and core technical teams. In countries such as Myanmar, the Task Force solely comprised the country's Department of Agriculture (Plant Protection Division) and Yezin Agricultural University.

No clear information was obtained on the frequency of Task Force meetings. While certain countries reported weekly infestation reports of FAW (e.g., Vietnam, North Korea, Philippines), other countries indicated that the Task Force and/or its technical sub-committees were meeting on a monthly basis (e.g., Philippines, Nepal, Thailand, Bangladesh). India, Myanmar and Vietnam signaled that high-level meetings (e.g., by a Task Force steering committee) were held 1-3 times per year. Clear / distinct roles were ascribed to different Task Force member institutions in Nepal, India, North Korea and PNG; other countries either did not specify the exact roles / functions of its institutional members, or rather placed emphasis on the collective activities by the entire Task Force (e.g., Bangladesh, Vietnam). For example, Vietnam indicated that the Task Force collective function was to access/collate information and guide province-level interventions against fall armyworm. Conversely, for Nepal, functions were clearly defined for five individual institutions (or institutional alliances): 1. MoALD, 2. PQPMC/NPPO, 3. NERC and NARC, 4. CIMMYT/iDE/Kissan II/Helvetas, and 5. FAO/PQPMC. A similarly detailed assignment of functions and roles to different national/province/county-level institutions was provided by North Korea.

In terms of national and international collaboration: eight (out of 12) countries confirmed a collaboration with national academia, while varying degrees of international collaboration were reported. A total of 4 countries signaled collaboration with FAO (i.e., Myanmar, Philippines, India and Vietnam). Other countries reported collaboration with CIMMYT (n=1), Australia National Museum (n=

1), Chinese government institutions (n=1), CABI (n=1). In terms of international donor-funded initiatives, assistance through JIRCAS and USAID was listed by Thailand and Myanmar respectively.

The achievements or progress of the National Task Force ranged substantially between the different countries and were likely shaped by national response capacity, FAW invasion history, country-level pest priorities and anticipated FAW-inflicted damage. In North Korea, more than 90% of IPM plans were implemented, involving FAW adult trapping, egg mass collection, pest prevention and quarantine action. Myanmar listed as its main achievement the identification, testing and mass-production of FAW natural enemies, e.g., *Trichogramma* egg parasitoids. In India or Vietnam, major achievements comprised a broad suite of activities covering e.g., the deployment of pheromone traps, natural enemy mass production, farmer training, public awareness-raising and capacity building. Vietnam equally listed the issuance of formal letters granting (temporary) approval of insecticide use and a listing of recommended synthetic products for FAW control as one of its major achievements.

The overall state of awareness among key stakeholders (i.e., farmers, extension personnel, academics, policy makers and government decision-makers) ranged from low in countries such as Bhutan, PNG and the Philippines to intermediate or high in Vietnam. While countries such as Vietnam, Philippines and Myanmar confirmed the presence of a formal FAW communication plan, multiple other countries indicated how a diverse range of communication tools and media were effectively used for technology transfer / awareness-raising. These comprised radio, TV, social media (Facebook, SMS, Line, Whatsapp), print media (newspaper, technical leaflets and brochures), educational video, face-to-face training e.g., of trainer-of-trainers (ToTs) and Farmer Field Schools (FFS).

## **Part I.2 – FAW infestation and impacts on maize production**

The maize agricultural season and its production calendar differed substantially between the different Asia-Pacific nations. Countries either reported continuous or non-seasonal cropping (e.g., PNG, Thailand specialty corn), 1 single cropping season (North Korea), 2 distinct seasons (Myanmar, India, Cambodia, Philippines) or 3 seasons (Vietnam, Bangladesh, Nepal).

Maize was listed as FAW host by all countries (except for Lao PDR, for which no response was received) and as the primary (or exclusive) host of *Spodoptera frugiperda* by Bhutan, Myanmar, Thailand, Vietnam and Cambodia. North Korea reported FAW presence on a broad suite of crops including sorghum, rice, wheat, barley and vegetables. Other countries reported the local presence of FAW on sorghum (Nepal, PNG, Philippines, India), cabbage (Bangladesh), rice (PNG) and sugarcane (PNG, Philippines).

Country-level production of maize (area) ranged from 2,500 hectares for PNG to 2.5 million and 9.5 million hectares for the Philippines and India, respectively. Most countries reported the presence of FAW in most (if not all) national maize production areas, while data were lacking on FAW geographic coverage in Vietnam. As such, from >500 over ~250,000 to 1.8 million farming households were likely to be affected in Bhutan, Thailand and North Korea (with national household size ranging from 2 to 4.6 persons).

Prior to the FAW invasion, country-level maize yields ranged from 2,680 kg/ha (Nepal), over 4,000-5,000 kg/ha (Myanmar, PNG) to 9,610 kg/ha for Bangladesh. Most countries did not possess (or report) formal yield loss levels. Based upon national production estimates, yield losses of 6.5%, 7.5% and 3.7% were inferred for Nepal, North Korea and India.

In terms of FAW prevalence (% infestation), only 6 (out of 12) countries provided clear estimates. Nepal and Bangladesh reported FAW prevalence levels of 0-80% and 5-60% fields, respectively. North Korea reported FAW presence in 40% maize, 1% rice and 5% millet crops. For Thailand and Vietnam, prevalence levels of 10-15% and 4.5% were recorded, while an average (field-level) infestation of 26.5% was signaled by the Philippines.

Yield loss estimates ranged greatly between the different reporting countries. Up till present, FAW-induced yield losses were low to moderate, with estimated losses of 2%, 2.0-4.8% and 6.4% for the Philippines, Myanmar and Nepal. For Nepal, such translated into a country-wide loss of US \$41,000. On the other hand, Vietnam reported 5-40% yield loss in FAW-affected areas, while Thailand estimated 25-40% losses nationwide. The latter translated into annual economic losses of US\$ 130-260 million.

All countries reported good quality, large-sized maize cobs and kernels before the FAW invasion. Following the FAW invasion, countries reported extensive feeding damage (Bhutan), smaller or deformed cobs (North Korea, Bangladesh), fungal infection of kernels & loss of marketability (Myanmar), lowered grain quality (Thailand) and the presence of larvae in harvested cobs (Vietnam).

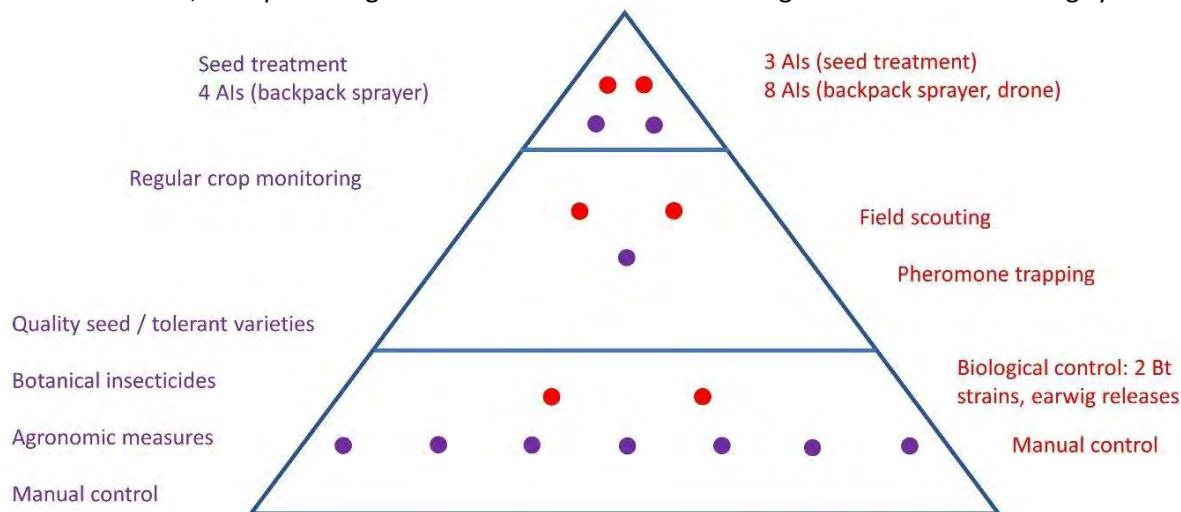
None of the countries provided details on the economics of maize/sorghum/millet or rice production before or after the FAW invasion. Yet, following the FAW invasion, both Vietnam and Myanmar signaled how farmer income was negatively impacted by both (FAW-inflicted) yield loss and pesticide expenditure.

### **Part I.3 – Capacity for FAW management**

Countries provided varying levels of detail on the nationally-endorsed FAW control measures, with 6 (out of 12) countries listing an extensive set of both preventative and preventative measures. Contrary to integrated pest management (IPM) guidelines, most countries placed disproportionate emphasis on the use of synthetic pesticides. In Thailand (Figure 1, right-hand country), a total of 8 active ingredients are recommended for either manual or drone-based applications, while 3 active ingredients are proposed for use as insecticidal seed treatments. These recommendations are mirrored by those of Cambodia, where biological control and insecticide use (6 active ingredients) are the only constituent components of the IPM pyramid for FAW. In North Korea, IPM recommendations primarily comprise chemical control tactics. Conversely, in Nepal, a total of 7 different avoidance practices (i.e., bottom of IPM pyramid) are listed, covering quality seed / tolerant varieties, botanical insecticides, a suite of agronomic measures and manual control (i.e., crushing) of *S. frugiperda* larvae and egg masses. Countries such as Bangladesh or the Philippines, similarly place (relatively more) emphasis on avoidance tactics such as balanced fertilization, biological control (SNPV, SfNPV) or botanicals.

Government-endorsed synthetic insecticides comprise a total of 15 different active ingredients (including product blends). Half of these substances (i.e., 8/15) are either highly hazardous products, are included in the list of the 10 most toxic compounds for use against fall armyworm (Jepson et al., 2019, The Lancet). Moreover, 5/15 active ingredients are currently banned for field use in the European Union (Table 1). North Korea endorses the use of methyl parathion and chlorpyrifos for FAW control; with the former product an extremely hazardous compound (class Ia) that's banned in most countries. Thailand further officially endorses the use of drones for insecticide spraying; this practice has also been trialed in countries such as Vietnam and Lao PDR (but does not feature in the countries' survey responses). Lastly, the treatment of maize seed with (systemic) insecticides is being promoted by Nepal, Thailand and Vietnam, even though this practice conflicts with multiple core IPM principles. The unguided,

preventative use of insecticide-coated seeds is often not economically justified; it further poses a threat to on-farm biota, disrupts biological control and undermines ecological resilience of farming systems.



**Figure 1.** Visualization of the exact make-up of integrated pest management (IPM) programs against FAW for Thailand (right) and Nepal (left). Recommended management practices are enumerated for three different layers of the IPM pyramid: preventative measures and avoidance tactics (lower level), detection tools and monitoring/scouting (middle level) and effective chemical use (upper level). The exact number of individual practices for either country is shown within the respective IPM pyramid layers.

**Table 1.** Full listing of the hazard profile and toxicity level of government-endorsed insecticides (active ingredients) for use against fall armyworm. Active ingredients include those listed by 12 Asia-Pacific countries.

Active ingredient	Number of countries	HHP <sup>a</sup>	Top-10 toxicity <sup>b</sup>	Banned in European Union
Chlorantraniliprole	4			
Spinosad / spinetoram	2/4		Y; pollinators	
Emamectin benzoate	5		Y; pollinators	
Indoxacarb	3			
Flubendiamide	3			
Methoxyfenoxide	1			
Cyantraniliprole	1			
Chlorpyrifos	1 (North Korea)	X	Y; inhalation	X
Methyl parathion	1 (North Korea)	X	Y; inhalation, avian acute + reproductive; small mammal	X
Thiamethoxam	1	X	Y; pollinators	X
Chlorfenapyr	1			
Lufenuron	2			
Fipronil	1	X	Y; pollinators	X
Imidacloprid	1	X	Y; pollinators	X

a. Highly-hazardous products (see Jepson et al., 2019. The Lancet)

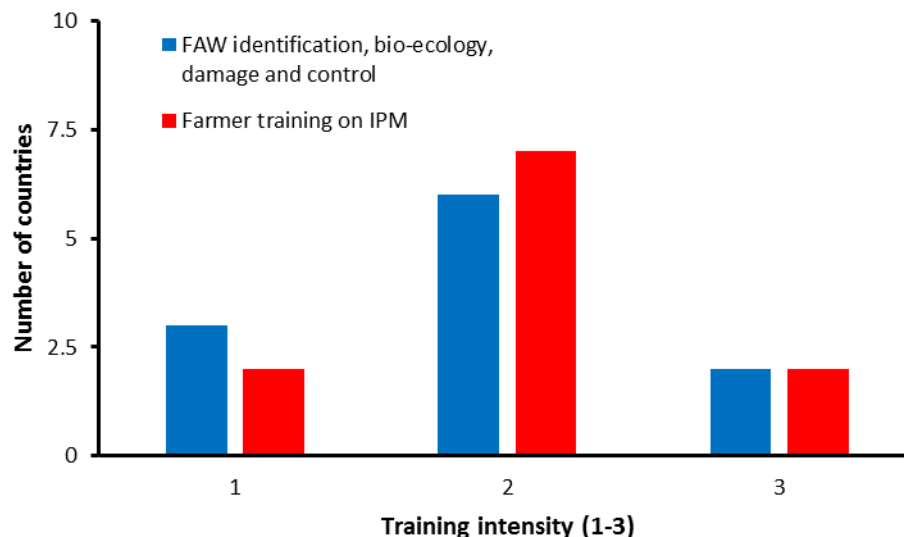
b. Included in 10 most toxic active ingredients (different toxicity categories; Jepson et al., 2019)

Four (out of 12) countries underline the effectiveness of the recommended synthetic pesticides, while

North Korea places emphasis on its use of rice straw/brushwood for *S. frugiperda* trapping. Thailand signals how both chemical and biological control is effective. The role of monitoring and early detection is underlined by Myanmar. Bhutan and Cambodia further indicate that synthetic pesticides pose a risk to human and environmental health, though there's a critical lack of awareness on the human health risks of pesticides and agrochemical suppliers continue to promote highly hazardous products (as signaled by Bangladesh). In Cambodia, maize farmers reportedly use 6 pesticide spray applications per cropping season. Contrarywise, Thailand signals that its recommended pesticides are economical, practical and present low risks to human and environmental health.

For most countries, current levels of (farmer) adoption of the promoted IPM technologies are low to intermediate. One notable exemption is North Korea, where almost universal adoption is recorded. Both Vietnam and Myanmar signal how most farmers continue to use pesticides. Several local innovations and/or important technology advances are being reported, including the country-level validation of push-pull strategies (Nepal), the use of vinegar, molasses and sugar traps/sprays (Vietnam, North Korea), pheromone traps (Myanmar), *Trichogramma* spp. releases (Myanmar), FAW-suppression through legume intercropping e.g., with pigeonpea, cowpea or black gram (India), and the validation of beneficial fungi and/or stink bug releases (Nepal, Lao PDR). Thailand highlights its advances in promoting insecticidal seed treatment and drone-based applications of crop protection products.

Countries show considerable variability in the extent of farmer training on different FAW-related topics, including its bio-ecology, distinguishing features, damage and management (including through IPM). Up till present, most countries report low to intermediate levels of training on the above topics (Figure 2). Also, in most countries, many recommended IPM practices await farm-level validation – though Vietnam and Myanmar report how participatory research (including through FFS) is being carried.



**Figure 2.** Extent of farmer training on different FAW-related topics among 11 reporting Asia-Pacific countries.

Countries report different mechanisms for farmer training on FAW and its management, including FFS, on-farm research trials, demonstration plots, use of multi-media (including print and electronic media). In certain countries (e.g., Myanmar), extension activities are being executed at the village- or township-level. In countries such as Nepal, a range of information materials are developed for distribution among

farmers: audio and visuals, educational fact sheets, photo guides, pest management decision guides, leaflets, pamphlets or SMS Scripts. North Korea, Vietnam and Bangladesh emphasize the use of video-materials, while other countries seem to rely more on print media. Face-to-face training (e.g., through extension officers) appears to be a prominent feature of FAW IPM training programs in Bhutan, Nepal, Philippines, Bangladesh, India and Vietnam.

Lastly, 7 (out of 12) countries report the existence of facilities for rearing natural enemies, though several countries e.g., Bangladesh, PNG report limited (physical) capacity to upscale production or a need for technical support.

## **Part I.4 – Monitoring, early warning and prevention of the further spread of FAW**

Countries report a broad suite of monitoring tools to track country-wide spread dynamics and regional infestation levels of fall armyworm, including pheromone traps, field scouting, FAO's FAMEWS app. A centralized reporting tool is available in countries such as Bhutan, and data-entry through a mobile application is being trialed in the Philippines. In Bangladesh, use of the FAMEWS is being encouraged, yet currently only covers <5% maize areas. Only 2 out of 12 countries report the use of Geographical Information Systems (GIS) for mapping and monitoring FAW pest populations.

Among all reporting countries, 11 confirm the presence of a national focal point to coordinate FAW monitoring and early warning (no response received from Lao PDR); 10 countries confirm the presence of a national plant protection network to address FAW. However, in Thailand, Vietnam and possibly Bhutan, the latter network covers a variety of crop-damaging pests and diseases. Lastly, only 4 (out of 12) countries indicate that an overarching policy and legal framework exists for FAW monitoring, early-warning and management.

## **Part I.5 – Comments from the National Task Force**

Multiple challenges are listed to effectively pursue country-wide coordination, FAW monitoring and IPM implementation. Key challenges for national coordination are a critical lack of manpower/budget/time, lack of a professional surveillance system and the need of training materials (e.g., digital displays for video showings, as brought up by North Korea). In some countries, a Task Force waits to be established (PNG) or currently lacks a budget and supervision (Thailand, Vietnam). Deficient internet connectivity limits national coordination in the Philippines. Challenges for FAW monitoring include the lack of a formal monitoring/early-warning system, ineffective lures, insufficient insights into FAW ecology, Covid-19 mobility restrictions and internet access that's limiting FAMEWS operability. As a solution, five countries (i.e., Philippines, Bangladesh, Vietnam, Bhutan, North Korea) propose the development of an automated, ICT-based monitoring and early-warning system, while emphasis is also placed on proper training of field scouts.

Lastly, key challenges for FAW management include insufficient resources to train farmers, local innovations that await validation, farmers lag in adopting non-pesticidal approaches, insufficient insights into FAW ecology, R&D needs in biological control / biopesticides (e.g., mass-rearing) and the lack of a

systems / area-wide pest management approach. As solutions, several countries proposed the allocation of additional resources to applied ecological research, a swift validation of local (farmer) innovations, the establishment of small-scale (cottage-style) production of natural enemies, and the prioritization of parasitoid rearing/distribution to maize growers. A full listing of proposed strategies to overcome challenges related to FAW mitigation is provided in Table 2.

**Table 2.** Listing of the (7) main strategies to overcome challenges related to FAW management among 12 Asia-Pacific countries.

Topic	B1	N1	N2	M	P1	T	P2	B2	I	V	C	L
Pursue (applied) research and deployment of biological control, incl. natural enemy rearing systems	X	X	X	X		X	X	X		X		
Develop (ICT-based) monitoring and early-warning system	X	X	X				X	X	X	X		
Advance training and capacity-building of farmers and extensionists	X	X				X	X		X	X		
Ensure timely availability / registration of biological control agents, biopesticides and pheromones				X		X		X	X			
Advance (area-wide) integrated pest management schemes			X									
Explore the potential for innovative finance and crop insurance systems						X						

B1: Bhutan, B2: Bangladesh; N1: Nepal, N2: North Korea; M: Myanmar; P1: Papua New Guinea, P2: Philippines; T: Thailand; I: India; V: Vietnam; C: Cambodia; L: Lao PDR

## Part II. Additional questions with specific relevance for the forthcoming FAW-IPM-biological control and Farmer Field Schools webinar series (as sent out in October 2020)

Up till present, the major findings of FAW research and development initiatives have comprised a strengthening of laboratories, natural enemy surveys, the validation of intercropping and push-pull strategies, the identification of promising insecticides and insecticide rotation schemes. In Lao PDR, farmer action research is pursued through a project funded by LURAS. Several management innovations are considered to carry promise for further up-scaling: pesticide rotation schemes and the use of Neem sprays (Nepal), pheromone-based monitoring (Myanmar), drone-application of chemical and biological pesticides (Thailand). In Cambodia and Lao PDR, *Telenomus remus* parasitoids, *Metarhizium anisopliae* fungi and predatory stink bugs are being trialed and their use potentially can be further promoted.

Six (out of 12) countries confirmed that IPM policy covered biological control, while 7 countries possessed natural enemy rearing facilities. For example, in Myanmar, existing *Trichogramma* rearing facilities (for rice stemborer control) could be adapted to mass-produce other species of egg parasitoids or entomopathogenic fungi. Certain countries explored the potential of parasitoids such as *Trichogramma* sp. and *Telenomus* sp., while others recommended the use of different *Bacillus thuringiensis* strains (Thailand, Vietnam), entomopathogenic fungi, NPV (Bangladesh, Philippines),

earwigs (Philippines, Thailand) and stink bugs (Lao PDR).

The Covid-19 pandemic has impacted farmer training events and overall FAW mitigation efforts. More specifically, several countries report how webinars have replaced face-to-face meetings and how increased use is made of social media (Facebook, Whatsapp), village posters, radio and TV broadcasts. Extension agents e.g., in Thailand implement social distancing and postponed face-to-face contacts. This has disrupted the timely organization of FFS and trainer-of-trainer (ToT) events. As a result, a range of online training resources have been developed, e.g., FFS training manuals, IPM protocols, FAW identification guide and fact sheets (Nepal). In Thailand, websites, radio clips and Youtube videos have all been developed and help circumvent Covid-19 related mobility restrictions.

Country representatives expressed an interest to share and discuss the following IPM technologies during future webinar series or workshops: biological control (Nepal, Cambodia), pesticide application technology and biological control (Thailand), advantages / disadvantages of conventional and digital FFS (Philippines, Cambodia), exchange of experiences and/or microbial strains for biological control (Philippines), botanical pesticides (Philippines) and farmer action research (Lao PDR).

## Annex V: List of and Links to materials on FALL ARMYWORM

### LIST OF and LINKS to MATERIALS on FALL ARMYWORM

Title/Type	Link	Description
<b>General</b>		
Fall Armyworm (Web page)	<a href="http://www.fao.org/fall-armyworm/en/">http://www.fao.org/fall-armyworm/en/</a>	Contains information on background, success stories, global action, sustainable management, monitoring, education and resources on FAW
Fall Armyworm Portal (Web page)	<a href="https://www.cabi.org/isc/fallarmyworm">https://www.cabi.org/isc/fallarmyworm</a>	This portal contains a selection of news, research, practical extension materials, videos and other resources on fall armyworm.
FAW Identification, Biology and Ecology (Primer)	<a href="http://www.fao.org/3/a-i7840e.pdf">http://www.fao.org/3/a-i7840e.pdf</a>	FAW identification, biology and ecology
Fall Armyworm Q and A (Primer)	<a href="http://www.fao.org/3/a-i7471e.pdf">http://www.fao.org/3/a-i7471e.pdf</a>	Questions and answers about FAW
FAMEWS Global Platform (Webpage)	<a href="http://www.fao.org/fall-armyworm/monitoring-tools/famews-global-platform/en/">http://www.fao.org/fall-armyworm/monitoring-tools/famews-global-platform/en/</a>	An online resource for mapping data collected by the FAMEWS mobile app whenever fields are scouted or pheromone traps are checked for FAW. The platform provides a real-time situation overview with maps and analytics of FAW infestations at global, country and sub-country levels.
FAW Map (Webpage)	<a href="http://www.fao.org/fall-armyworm/monitoring-tools/faw-map/en/">http://www.fao.org/fall-armyworm/monitoring-tools/faw-map/en/</a>	Map of the worldwide spread of fall armyworm since 2016 (as of March 2020).
FAO's Position on the Use of Pesticides to Combat FAW (Primer)	<a href="http://www.fao.org/3/a-i8022e.pdf">http://www.fao.org/3/a-i8022e.pdf</a>	Pesticides play an important role in managing pests such as the Fall Armyworm, however they can also pose unacceptable risks to human health and the environment. Pesticide risk reduction and risk management are essential to the responsible use of pesticides.
FAW Research Collaboration Portal (Website)	<a href="https://faw.researchcollaborationportal.org/">https://faw.researchcollaborationportal.org/</a>	The CABI-led Fall Armyworm Research Collaboration Portal, is a free-to-access platform to share research data, insights and outputs.
Implementation Plan for the Global Action for FAW Control	<a href="http://www.fao.org/3/ca9210en/ca9210en.pdf">http://www.fao.org/3/ca9210en/ca9210en.pdf</a>	Implementation plan for the Global Action for FAW control
The Global Action for FAW Control	<a href="http://www.fao.org/3/ca9252en/ca9252en.pdf">http://www.fao.org/3/ca9252en/ca9252en.pdf</a>	The Global Action for Fall Armyworm Control: Action framework 2020–2022

Title/Type	Link	Description
Regional Workshop for Asia Sustainable Management of FAW (Report)	<a href="http://www.fao.org/3/ca7615en/ca7615en.pdf">http://www.fao.org/3/ca7615en/ca7615en.pdf</a>	Report of the regional workshop for Asia: Sustainable management of fall armyworm
Fall armyworm ( <i>Spodoptera frugiperda</i> ) management by smallholders (Article)	<a href="https://www.cabi.org/cabreviews/FullTextPDF/2019/20193352460.pdf">https://www.cabi.org/cabreviews/FullTextPDF/2019/20193352460.pdf</a>	The article examines differences between large-scale producers and smallholder farmers and surveys the literature for accessible management options for smallholders, largely based on locally available solutions using ecological knowledge. The article also looks at how innovative digital solutions may also play a role in helping farmers learn about and share locally available solutions.
List of FAW Publications	<a href="http://www.fao.org/3/ca9395en/ca9395en.pdf">http://www.fao.org/3/ca9395en/ca9395en.pdf</a>	List of FAW publications
<b>Manuals</b>		
Running Farmer Field Schools in Times of COVID-19: A Resource Handbook (Manual)	file:///C:/Users/Dada/Downloads/CA9064EN%20(1).pdf	This handbook provides guidance and suggestions to farmer field school (FFS) facilitators, master trainers, project coordinators and rural advisors on running FFS and other agricultural training activities in times of COVID-19. It includes basic protective measures, important considerations, proposed FFS activities, links to the World Health Organization (WHO) resources and videos and more.
Integrated Management of the Fall Armyworm on Maize: A Guide for FFS in Africa (Manual)	<a href="http://www.fao.org/3/i8665EN/i8665en.pdf">http://www.fao.org/3/i8665EN/i8665en.pdf</a>	The guide covers topics on scouting and trapping, biology and ecology of FAW, biological control, biopesticides, plant compensation, local practices, synthetic insecticides, plant diversity and agro-ecology, the push-pull technology, IPM principles in FFS.
Community-based FAW Monitoring, Early Warning and Management: Training of Trainers Manual	<a href="http://www.fao.org/3/CA2924EN/ca2924en.pdf">http://www.fao.org/3/CA2924EN/ca2924en.pdf</a>	This manual provides farmers and frontline community extension service providers with easy-to-use information on how they can manage FAW within their smallholder cropping systems. It provides information about modules for training trainers in FAW pest diagnostics, scouting, management and data collection.
<b>Guidance Note</b>		
FAW Guidance Note 1: Reduction of Human Health and Environmental Risks of Pesticides Used for Control of FAW	<a href="http://www.fao.org/3/i8320EN/i8320en.pdf">http://www.fao.org/3/i8320EN/i8320en.pdf</a>	Reduction of human health and environmental risks of pesticides used for control of FAW
FAW Guidance Note 2: FAW Scouting	<a href="http://www.fao.org/3/i8321EN/i8321en.pdf">http://www.fao.org/3/i8321EN/i8321en.pdf</a>	Procedure for scouting for FAW
FAW Guidance Note 3: FAW Trapping	<a href="http://www.fao.org/3/i8322EN/i8322en.pdf">http://www.fao.org/3/i8322EN/i8322en.pdf</a>	The presence and build-up of FAW in a particular area can be detected by using pheromone traps. Moths that are caught are then counted. From these numbers, farmers can know if

Title/Type	Link	Description
		FAW is present in their fields and if there is a need for increased scouting.
FAW Guidance Note 5: FAW Early Action Policy Guide	<a href="http://www.fao.org/3/ca3800en/ca3800en.pdf">http://www.fao.org/3/ca3800en/ca3800en.pdf</a>	This policy guide reviews the experiences and lessons learned from over 40 countries that have had to make quick policy and technical decisions that have set the groundwork for sustainable management of FAW.
FAW Guidance Note 6: FAW in Africa - FAO's position on the use of GM maize	<a href="http://www.fao.org/3/i8023en/i8023en.pdf">http://www.fao.org/3/i8023en/i8023en.pdf</a>	FAW in Africa: FAO's position on the use of GM maize
FAW Guidance Note 7: Assessing the impact of COVID-19 on the Global Action for FAW Control	<a href="http://www.fao.org/3/ca8652en/ca8652en.pdf">http://www.fao.org/3/ca8652en/ca8652en.pdf</a>	Assessing the impact of COVID-19 on the Global Action for FAW Control
FAW Guidance Note 8: Global Action for Control (Guidance Note)	<a href="http://www.fao.org/3/ca8797en/ca8797en.pdf">http://www.fao.org/3/ca8797en/ca8797en.pdf</a>	The Global Action for Fall Armyworm Control, aims to mobilize USD 500 million over three years, from 2020 to 2022, for radical, direct and coordinated measures to strengthen monitoring and pest control capacities at global level.
FAW Guidance Note 9: Technical guidelines for sustainable management of FAW in its year-round breeding areas (Guidance Note)	<a href="http://www.fao.org/3/ca8967en/ca8967en.pdf">http://www.fao.org/3/ca8967en/ca8967en.pdf</a>	Technical guidelines focused on delineating management strategies for regions in Africa, the Near East and Asia in which FAW can survive and breed year-round.
FAW Guidance Note 10: FAW Monitoring and Early Warning System (Guidance Note)	<a href="http://www.fao.org/3/ca9484en/ca9484en.pdf">http://www.fao.org/3/ca9484en/ca9484en.pdf</a>	An integral part of FAO's Global Action for Fall Armyworm Control is the FAW Monitoring and Early Warning System (FAMEWS), which consists of a mobile app for data collection and a global platform for mapping.
FAW Guidance Note 11: Technical guidelines for sustainable management of FAW along its seasonal migration pathways (Guidance Note)	<a href="http://www.fao.org/3/ca9486en/ca9486en.pdf">http://www.fao.org/3/ca9486en/ca9486en.pdf</a>	Technical guidelines for sustainable management of fall armyworm along its seasonal migration pathways
FAW Guidance Note 12: Synthetic Pesticides Risk Reduction (Guidance Note)	<a href="http://www.fao.org/3/cb0680en/cb0680en.pdf">http://www.fao.org/3/cb0680en/cb0680en.pdf</a>	This guidance note will raise awareness of the risks posed by these synthetic pesticides. It also provides information on risk mitigation measures, while discouraging the unwarranted use of HHPs.
<b>Videos</b>		
Killing FAW naturally (Video)	<a href="https://www.accessagriculture.org/killing-fall-armyworms-naturally">https://www.accessagriculture.org/killing-fall-armyworms-naturally</a>	By making best use of farmers' friends and local plants on the farm, nature will help you control the fall armyworm and reward you with a good and healthy crop.
Scouting for Fall Armyworms (Video)	<a href="https://www.accessagriculture.org/scouting-fall-armyworms">https://www.accessagriculture.org/scouting-fall-armyworms</a>	Spraying pesticides is expensive and usually cannot control this pest. Visit your field twice a week for the first 6 weeks and kill any egg masses and young armyworms by hand. It is

Title/Type	Link	Description
		important to do scouting because without it, you will not have a harvest at the end of the day.
Neem seed kernel extract	<a href="https://www.accessagriculture.org/neem-seed-kernel-extract">https://www.accessagriculture.org/neem-seed-kernel-extract</a>	Unlike most botanical insecticides, the plants can take up neem extracts through their roots and leaves, spreading the material throughout the plant tissues. For this reason, neem can help control pests like leaf miners, which feed inside leaves and are normally not affected by sprays that only cover the outside of the plant.
Introduction to FAW and bio-control (Part 1)	<a href="https://www.youtube.com/watch?v=92Zpwcx7HkA">https://www.youtube.com/watch?v=92Zpwcx7HkA</a>	Video clips on Fall Armyworm and general bio-control in Thai language.
Introduction to FAW and bio-control (Part 2)	<a href="https://www.youtube.com/watch?v=A2WceYHVpEU&amp;t=244s">https://www.youtube.com/watch?v=A2WceYHVpEU&amp;t=244s</a>	Video clips on Fall Armyworm and general bio-control in Thai language.
Thailand Bio-control for FAW (English)	<a href="https://youtu.be/nnkWT25lkiI">https://youtu.be/nnkWT25lkiI</a>	Introduction to Bio-control for FAW and some simple rearing process.
Ear wick, Trichogramma Wasp, Trichoderma, BT and NPV	<a href="https://www.youtube.com/channel/UCeSU-rK1BfCzOv-492F1LSA">https://www.youtube.com/channel/UCeSU-rK1BfCzOv-492F1LSA</a>	Short video clips on rearing process in Thai, Burmese, Khmer, Hindi, and Vietnamese. (being translated)
How to Identify and Scout for Fall Armyworm in Laos (Video)	<a href="https://www.youtube.com/watch?v=tUtlEWJ784k&amp;feature=youtu.be">https://www.youtube.com/watch?v=tUtlEWJ784k&amp;feature=youtu.be</a>	How to identify and scout for Fall Armyworm (Laos)
How to Identify and Scout for Fall Armyworm in Bengali (Video)	<a href="https://www.youtube.com/watch?v=FjIF43ViQEw">https://www.youtube.com/watch?v=FjIF43ViQEw</a>	How to identify and scout for Fall Armyworm (Bangla)
Fall Armyworm life cycle in Bangla (Video)	<a href="https://www.youtube.com/watch?v=DBXyh3kBPU4">https://www.youtube.com/watch?v=DBXyh3kBPU4</a>	Fall Armyworm life cycle (Bangla)
How to Identify and Scout for Fall Armyworm in English (Animation)	<a href="https://www.youtube.com/watch?v=5rxlpXEK5g8">https://www.youtube.com/watch?v=5rxlpXEK5g8</a>	How to identify and scout for Fall Armyworm (English)
How to Identify and Scout for Fall Armyworm in Burmese (Animation)	<a href="https://sawbo-animations.org/video.php?video=//www.youtube.com/embed/WUI40HQulyw">https://sawbo-animations.org/video.php?video=//www.youtube.com/embed/WUI40HQulyw</a>	How to Identify and Scout for Fall Armyworm (Burmese)
How to Identify and Scout for Fall Armyworm in Chinese (Animation)	<a href="https://sawbo-animations.org/video.php?video=//www.youtube.com/embed/J6Id9IRfzoA">https://sawbo-animations.org/video.php?video=//www.youtube.com/embed/J6Id9IRfzoA</a>	How to Identify and Scout for Fall Armyworm (Chinese)

Title/Type	Link	Description
How to Identify and Scout for Fall Armyworm in Hindi (Animation)	<a href="https://sawbo-animations.org/video.php?video=//www.youtube.com/embed/LINDUhFCBTs">https://sawbo-animations.org/video.php?video=//www.youtube.com/embed/LINDUhFCBTs</a>	How to Identify and Scout for Fall Armyworm in Hindi
Biological Control of Fall Armyworm in Maize in Bangladesh (Video)	<a href="https://www.youtube.com/watch?v=wDVziOykWIY&amp;feature=youtu.be">https://www.youtube.com/watch?v=wDVziOykWIY&amp;feature=youtu.be</a>	Biological Control of Fall Armyworm in Maize in Bangla
Fall Armyworm life cycle (Video Factsheet)	<a href="https://www.youtube.com/watch?v=eZxVouWM-t4&amp;feature=youtu.be">https://www.youtube.com/watch?v=eZxVouWM-t4&amp;feature=youtu.be</a>	Fall Armyworm life cycle
Fighting Against FAW (Drama)	<a href="https://www.youtube.com/watch?v=cV4dOfdVdsw&amp;feature=youtu.be">https://www.youtube.com/watch?v=cV4dOfdVdsw&amp;feature=youtu.be</a>	Fall Armyworm management
<b>Poster</b>		
Prevention to eliminate polka-dot cornworms in different types of corn (Thai)	<a href="http://www.doa.go.th/plprotect/?p=3028">http://www.doa.go.th/plprotect/?p=3028</a>	Poster on FAW management (Thai)
<b>Radio</b>		
Radio broadcasting station for agriculture (Thai)	<a href="https://www.am1386.com/home/1272">https://www.am1386.com/home/1272</a>	Agriculture radio programmes (Thai)
<b>Datasheet</b>		
Fall Armyworm: Identification and management (Datasheet)	<a href="https://www.cabi.org/isc/datasheet/29810">https://www.cabi.org/isc/datasheet/29810</a>	Fall Armyworm: Identification and management
Pest Management Decision Guides in Nepali (Datasheet)	<a href="https://www.cabi.org/isc/FullTextPDF/2019/20197800519.pdf">https://www.cabi.org/isc/FullTextPDF/2019/20197800519.pdf</a>	Pest Management Decision Guides in Nepali
<b>Leaflet</b>		
FAW Management Factsheet in Sinhalese (Leaflet)	<a href="http://www.doa.gov.lk/images/slideshow/2018/army_worm/army_worm_handbil.pdf">http://www.doa.gov.lk/images/slideshow/2018/army_worm/army_worm_handbil.pdf</a>	FAW Management Factsheet in Sinhalese
FAW Management Factsheet in Tamil (Leaflet)	<a href="https://www.doa.gov.lk/images/news/2019/SenaDalambuwa/finalArmywormleafletTAMILNew.pdf">https://www.doa.gov.lk/images/news/2019/SenaDalambuwa/finalArmywormleafletTAMILNew.pdf</a>	FAW Management Factsheet in Tamil
<b>Application</b>		
FAMEWS Mobile App (Webpage)	<a href="http://www.fao.org/fall-armyworm/monitoring-tools/famews-mobile-app/en/">http://www.fao.org/fall-armyworm/monitoring-tools/famews-mobile-app/en/</a>	An application for Android v6 or higher smartphones. The app should be used every time a field is scouted and pheromone traps are checked for FAW. (Download using the QR Code)