Food and Agriculture Organization of the United Nations

TIME-CRITICAL MEASURES TO SUPPORT EARLY WARNING AND MONITORING AND SUSTAINABLE MANAGEMENT OF THE FALL ARMYWORM IN INDIA

March 2022

SDGs:	
Country:	India
Project Code:	TCP/IND/3709
FAO Contribution:	USD 300 000
Duration:	24 September 2019 – 31 December 2021
Contact Info:	FAO Representation in India FAO-IN@fao.org

Implementing Partner

Ministry of Agriculture and Farmers Welfare (MoAFW).

Beneficiaries

Maize-growing farmers.

Country Programming Framework (CPF) Outputs

CPF Priority Area 3: Increase resilience of rural livelihoods to climate change, recurrent natural disasters and assistance in transboundary cooperation.

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BACKGROUND

The Fall armyworm (FAW; *Spodoptera frugiperda*) is a transboundary insect pest native to the Americas. It was first officially reported in India in August 2018 and was initially confined to the Southern State of Karnataka. FAO immediately shared guidance notes, training material and management recommendations on FAW with key national stakeholders, and warned the Government of India of the likelihood of its spread to the entire country. The Government issued advice to States, set up a High Power Committee and conducted surveys and surveillance through Central Integrated Pest Management Centres (CIPMCs), and awareness-raising activities for farmers.

In June 2019, FAO support was requested as the infestation had spread to 20 States (Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Uttar Pradesh, Sikkim, Meghalaya, Manipur, Mizoram, Nagaland, Odisha, Tamil Nadu, Telangana, Tripura and West Bengal), spanning all ecologies from south to north. The total affected area by the end of June 2019 was officially reported at 376 242 ha, and was expected to continue to expand with the onset of the main kharif (rainy) season.

In India, as in other countries, FAW has primarily been found on maize, but has also caused limited damage to sorghum, millets, sugarcane and rice. The main concern remains maize, however, as the third cereal crop in the country after rice and wheat. An estimated 89 percent of maize production is for domestic consumption, including animal consumption and industrial uses (corn oil, starch, etc.). Compounded by drought, FAW infestation has led to an estimated annual shortfall of almost 500 000 tonnes in maize output, prompting the government to allow maize imports under concessional duty.

State Departments of Agriculture (SDAs) and farmers have repeatedly expressed concern with regard to FAW's effect on food security and its economic impact on maize during kharif season. Researchers and civil society organizations have questioned the widespread use of pesticides, some of which are highly toxic, as these may worsen the problem, be economically inefficient and increase farmers' indebtedness.

The aim of the project was to immediately mitigate the negative impacts of FAW in two ways: i) by preventing or reducing yield losses and economic and food security impacts; and ii) by limiting the use of highly hazardous insecticides to protect the health of humans and ecosystems, and safeguard livelihoods. This would be achieved by supporting mass information campaigns and providing training in FAW for farmers and relevant stakeholders during kharif through the farmer field school (FFS) approach, and by supporting improved early warning and monitoring for FAW in order to generate real-time knowledge on host range and migration patterns in the country's agro-ecologies and cropping systems. The project would also fine-tune and roll out the sustainable management of FAW through the promotion of ecology-based integrated pest management (IPM), the promotion of biological control options and a review of regulatory frameworks.

IMPACT

The project has made a significant contribution to the management of FAW in maize-growing areas in the country. The coordinated multi-stakeholder approach adopted under the project will accelerate new knowledge, build capacity and networks, and demonstrate the value of integrated action for sustainable FAW management not only in India, but throughout the region, protecting food security, increasing productivity and incomes, and ensuring sustainable food and agricultural systems.

Achievement of results

All three envisaged project outputs, regarding capacity-building, monitoring and early-warning systems, and the dissemination of information, respectively, were delivered. The project provided technical assistance to enhance support and roll out strategies for the sustainable management of FAW in maize-growing regions. Relevant training programmes were designed and implemented and a manual produced on FFS-IPM specific to the management of FAW. Delays caused by the COVID-19 pandemic did not impede other implementation activities, which included the collection of baseline data on FAW, monitoring, surveillance and early warning activities in maize-growing ecologies of the country, and the demonstration of bio-intensive pest management (BIPM) modules and good agriculture practices (GAP) for the sustainable management of FAW in maize. With project support, the national-level action plan for FAW management was strengthened and the value of integrated action for sustainable FAW management was demonstrated. Altogether, these activities made a significant contribution to FAW management in maize-growing areas in the country.

Implementation of work plan and budget

The project was implemented during the COVID-19 pandemic. This led to delays in some activities and a no-cost extension was granted to allow these to be completed. The second wave of COVID-19 further impeded field-level training and some activities involving travel could not be undertaken because of pandemic-related restrictions, Despite this, many field-based activities were carried out and all activities were implemented within the planned budget.

Risks were effectively managed through constant monitoring and support from FAO Regional and Country Offices and FAO headquarters. At national level, there was also effective coordination among different stakeholders.

Follow-up for government attention

Concerted efforts should be made by the Directorate of Plant Protection, Quarantine and Storage (DPPQS) and by Departments of Agriculture (DOAs) to continue the awareness programmes introduced under the project and to provide training to farmers and all concerned stakeholders in the sustainable management of FAW.

Sustainability

1. Capacity development

The existing National Action Plan for the sustainable management of FAW in maize assisted in the effective development of specific programmes for FAW management and will continue to contribute to sustainability, as will the use of GAP in maize production.

The project collaborated with institutions with a mandate for maize production and supported the implementation of national policies and programmes related to agriculture. It also helped to strengthen the alliance between agriculture institutions and farmers involved in the production of maize. This is essential for effective FAW monitoring, surveillance, the implementation of GAP and the responsible use of agro-ecological and landscape management in agriculture-related maize-growing ecologies. The sharing of lessons learned by the participating country and of international experience also contributed to project sustainability.

During the project's interactive workshop, challenges, opportunities and strategies in mitigating FAW risk in agriculture were identified. The points that emerged from the workshop clearly show that the country is well equipped to sustain activities on its own and recognizes the need to prioritize these activities at national level.

2. Gender equality

Gender equality was considered in all workshops aimed at discussing legislative support, as well as during training and implementation activities. Women accounted for more than 25 percent of participants in workshops and training programmes.

3. Environmental sustainability

The project contributed to mitigating FAW risks in maize production. This has improved the perception of agriculture among consumers, while the adoption of GAP has contributed to mainstreaming environmental sustainability.

4. Human Rights-based Approach (HRBA) – in particular Right to Food and Decent Work

All policy and legislative interventions were aligned through a consultative process involving all stakeholders, including small farmers and producers. Agriculture is a major contributor to the food supply in India and improvements in maize production through GAP will contribute to improving food availability. Agriculture involves rural communities and women in a substantial way and improvements in agriculture contribute to the creation of gainful employment for women and rural youth.

5. Technological sustainability

The technologies introduced include those contributing to GAP in maize production technology. These are appropriate and flexible enough to be applicable to small, marginal and large maize-growing farmers in the country.

All project activities were based on skilled local expertise and knowledge related to rural agriculture, which has been improved to minimize the risk of FAW infestation in maize production.

All stakeholders have the capacity to pursue activities independently without further technical assistance.

6. Economic sustainability

It is to be expected that support will be provided by other donors for the activities introduced under the project as this would lead to improvements in maize production and productivity for rural communities and women. The products and services provided by the project are beneficial to both maize-growing farmers and consumers.

DOCUMENTS AND OUTREACH PRODUCTS

- **FAO & Directorate of Plant Protection Quarantine and Storage, Government of India.** 2021. *FFS IPM manual for the management of Fall armyworm* (in English). New Delhi. 108 pp. www.fao.org/3/cb3963en/cb3963en.pdf
- **FAO & Directorate of Plant Protection Quarantine and Storage, Government of India.** 2021. *FFS IPM manual for the management of Fall armyworm* (in Hindi). (Available upon request.).

ACHIEVEMENT OF RESULTS - LOGICAL FRAMEWORK

Expected Impact	**Government of India and farmers are empowered to minimize FAW impacts to protect food security (SDG 2.1), productivity and incomes (SDG 2.3) and sustainable food and agriculture systems (SDG 2.4)**	
Outcome	Improved monitoring and surveillance systems, awareness and capacities of farmers and trainers and institutional frameworks are in place to contain the FAW spread and manage it sustainably	
	Indicator	– Major maize-producing States are exposed to and are applying sustainable management options of the FAW. – Availability of field capacities to sustainably manage FAW.
	Baseline	0
	End Target	– At least ten major maize-producing States are aware of, and are applying, sustainable management options. – Capacities are built at all levels in three States for ecology-based IPM and biocontrol.
	Comments and follow-up action to be taken	The abovementioned targets were fully achieved. 1. The project organized zone-wise five virtual training events to create awareness on monitoring and surveillance for the sustainable management of FAW in maize during 2020, covering all five maize-growing regions, and including all States. An exclusive training event was held with international speakers from various organizations on the sustainable management of FAW in maize and a further training event was organized on FAW monitoring and sustainable management for Nagaland State in 2021. Five three-day training events on on-farm production protocols and how to conduct agro-ecosystem analysis for FAW management at landscape level were also conducted. 2. Capacities were built in the mass production and the on-farm production of bioagents, entomopathogenic fungi (EPF), entomopathogenic nematodes, other microbial agents and predators and ecology-based IPM, and the agro-ecological and landscape management of FAW in maize in five maize-growing ecologies. Concerted efforts should be made by DPPQS and DOAs to continue these awareness programmes and training with regard to the sustainable management of FAW.

Output 1	Strengthened awareness and capacities of government staff, rural advisory services and farmers to manage FAW sustainably in the short and long term		
	Indicators	Target	Achieved
	– Number of participants trained, disaggregated by gender. – Number of communication material disseminated.	– 80 participants from at least ten key maize-producing States sensitized during workshop. – 15 different communication materials produced, translated and disseminated (including FAO FAW FFS material in local languages).	Yes
Baseline	0		
Comments	Government staff and farmer capacities were built on sustainable management strategies; rural advisories on FAW management are now in place. Specialists from FAO, the International Maize and Wheat Improvement Centre, the Indian Council of Agriculture Research-Indian Institute of Maize Research (ICAR-IIMR), the ICAR-National Bureau of Agriculture Insects Resources (ICAR-NBAIR), the ICAR-Agricultural Technology Application Research Institute, (ICAR-ATARI) and DPPQS, along with 122 participants including scientists from State Agriculture Universities (SAUs) and Krishi Vigyan Kendras (KVK), and officers from SDAs and CIPMCs from different states took part in the workshop on the sustainable management of FAW in maize. Five one-day virtual training events on “Integrated Pest Management for Maize Crop with special reference to FAW” were conducted in different states on 4, 10 and 18 September, and 9 and 15 October 2021, respectively, for 465 participants, including scientists from ICAR, SAUs and KVK, and officers from SDAs and CIPMC from the states of Andhra Pradesh, Telangana, Tamil Nadu, Kerala, Karnataka, Maharashtra, Madhya Pradesh, Chattisgarh, Odisha, Madhya Pradesh, Rajasthan, Haryana, Punjab, Uttarakhand Himachal Pradesh, Jammu Kashmir, Delhi, Bihar, Uttara Pradesh Jharkhand, West Bengal, Assam and North Eastern states of the country. One training event was organized on 24 May 2021 on “Awareness training programme on FAW management on Maize in Nagaland” for 52 officers from Nagaland State. A total of 557 participants took part in five three-day virtual training events on the on-farm and mass production protocols of bio-agents and microbial agents for FAW management, on 28-30 September, 6-8 and 25-27 October, and 15-17 and 23-25 November 2021, respectively. The participants were scientists from ICAR, SAU, KVK, and officers from SDAs and CIPMC from the states of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana, Maharashtra, Gujarat, Rajasthan Madhya Pradesh, Odisha, Delhi, Haryana, Himachal Pradesh, Punjab, Jammu and Kashmir, Uttarakhand, Bihar, Jharkhand, Uttara Pradesh, West Bengal, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. Farmers and staff are now able to develop on-farm and mass production protocols of bio-agents and microbial agents in local field conditions. Concerted efforts by DPPQS should be made to continue building the capacities of farmers and staff for the sustainable management of FAW as the pest is still new to farmers.		

Activity 1.1	Overview of FFS and farmer training and outreach mechanisms	
	Achieved	Yes
	Comments	Each State has CIPMC units and the SDA extension network. Professionals from the CIPMC units, SDAs and ICAR were identified by DPPQS to receive training of trainers (TOT) training in FAW at five zonal centres.
Activity 1.2	Identify main project partners in three selected States	
	Achieved	Yes
	Comments	The Department of Agriculture Cooperation and Farmers Welfare (DAC & FW) and DPPQS identified farmers, extension workers, non-governmental organizations (NGOs) and stakeholders at district level and defined their role in project activities in coordination with the SDA.
Activity 1.3	National Workshop	
	Achieved	Yes
	Comments	A National Inception Workshop was held at the National Institute of Plant Health Management (NIPHM), Hyderabad, from 29 to 30 November 2019. The workshop was attended by representatives from MoAFW; CIPMCs; NIPHM; ICAR and concerned institutes, including NBAIR and IIMR; SDAs including All India Coordinated Research Project (AICRP) Maize and AICRP Biocontrol; scientists from KVKs; FAO FAW experts; and scientists from SAUs. The following were achieved: – Ecology-based IPM and biological control methods disseminated. – Well-informed mass information campaigns and training in FAW implemented through FFS for farmers and trainers. – Support provided for improved early warning and monitoring of FAW and real-time knowledge generated across Indian agro-ecologies and cropping systems. – Comprehensive strategies, i.e. administrative strategies, technical strategies, and information and communication technology defined for the effective management of FAW. At the end of the year, an interactive workshop was organized to conclude and disseminate the key lessons learned by the project and to emphasize the role of FFS and the mass production of natural enemies for the management of FAW. Concerted efforts have been made by DPPQS and other stakeholders to continue building the capacities of the staff and farmers for management of FAW and to conserve natural enemies in the maize ecosystem.
Activity 1.4	Training and outreach material	
	Achieved	Yes
	Comments	Apart from training events, a manual on FFS-IPM for FAW management was developed by FAO and DPPQS in English and in Hindi, and distributed to CIPMCs of all states and districts. The manual will help extension service workers to understand the various management strategies and assist farmers in the adoption of best practices for the management of FAW through FFS.
Activity 1.5	Training of agriculture staff and FFS Master Trainers at central level and in three States	
	Achieved	Partially
	Comments	Each State implemented a season-long FFS on FAW in collaboration with CIPMCs on TOTs. Altogether, 690 and 351 FFS were organized under the Regional CIPMC Bengaluru, covering 21 040 and 10 530 trainees, including agricultural extension officers, NGOs, lead farmers and private entrepreneurs, in 2019-2020 and 2020-2021, respectively. Season-long training programmes were also held by CIPMCs. An FFS on sustainable management in physical mode was organized by NIPHM, DPPQS and ICAR-IIMR at Hyderabad for farmers of KV Ranga Reddy district of Telangana. Because of the COVID-19 pandemic, many such FFS in physical mode could not be organized.
Activity 1.6	Support to States in implementation of FFS, short hands-on farmer training and farmer-to-farmer exchanges	
	Achieved	Partially
	Comments	CIPMC, ICAR, DOA and SAU supported master trainer TOTs to organize both physical and virtual training events at each KVK in FAW-infested or FAW-prone districts.

<table>
<tr><td rowspan="3">Output 2</td><td colspan="3">Improved monitoring and early warning systems for FAW</td></tr>
<tr><td>Indicators</td><td>Target</td><td>Achieved</td></tr>
<tr><td>– Improved systems for monitoring and early warning of FAW in India.
– Number of States sensitized and trained.</td><td>Departments of Agriculture in at least ten maize-producing States have been sensitized and trained in the use of application-based early warning system.</td><td>Yes</td></tr>
<tr><td>Baseline</td><td colspan="3">0</td></tr>
<tr><td>Comments</td><td colspan="3">This output was fully achieved through the following activities:
– Monitoring was carried out through pheromone lures using slow-releasing dispensers developed by ICAR-NBAIR and the FAMWES application to record match catches in the trap through AICRP Biocontrol and AICRP Maize and also by the regular monitoring conducted by CIPMC centres located in the respective States and covering the majority of the States in the country.
– Both DPPQS and ICAR sensitized the various states on monitoring and provided advice to stakeholders in the different states through CIPMC, KVK, AICRP centres, SAUs and DOA.</td></tr>
<tr><td rowspan="3">Activity 2.1</td><td colspan="3">Customize a harmonized monitoring and early warning system with real-time data collection and analysis on FAW in India</td></tr>
<tr><td>Achieved</td><td colspan="2">Partially</td></tr>
<tr><td>Comments</td><td colspan="2">The FAMEWS application was customized for India, translated into eight regional languages (Bengali, Gujarati, Hindi, Kannada, Marathi, Punjabi, Tamil and Telugu) and disseminated through training to stakeholders. Regular advice is disseminated through the different applications by DAC & FW and ICAR (ICAR-IIMR, ICAR-NBAIR and NCIPM) on the presence of FAW, natural enemies and agro-ecological factors.
The real-time data collection and analysis of FAW in India could not be conducted because of the COVID-19 pandemic. An institute will be identified by DPPQS for the upkeep, maintenance and analysis of data, and the issuance of suitable advisories.</td></tr>
<tr><td rowspan="3">Activity 2.2</td><td colspan="3">Capacity development</td></tr>
<tr><td>Achieved</td><td colspan="2">Partially</td></tr>
<tr><td>Comments</td><td colspan="2">1. Data from FAMEWS were verified by active field surveillance data in identified districts.
2. Pilot training in field data collection was organized with field staff.
3. Training in data analysis with state and central government staff was held during the 2021 kharif and rabi seasons.
Activities were only partially achieved because of the COVID-19 pandemic. Virtual training was provided to master trainers, and subsequently to field staff, on field data collection by CIPMC, SDA and ICAR through ICAR-IIMR.</td></tr>
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<tr><td rowspan="3">Output 3</td><td colspan="3">Evidence is documented and shared to support policy response and roll out of sustainable management strategies for FAW in the mid and long term</td></tr>
<tr><td>Indicators</td><td>Target</td><td>Achieved</td></tr>
<tr><td>Reports on efficacy of ecology-based IPM, biological control and low-cost control measures; and on risk and efficacy of insecticides.</td><td>Three reports on efficacy of sustainable management options; and risk and efficacy of synthetic insecticides.</td><td>Yes</td></tr>
<tr><td>Baseline</td><td colspan="3">0</td></tr>
<tr><td>Comments</td><td colspan="3">The above activity was fully achieved. Information was provided and reports produced on a regular basis by DPPQS and ICAR (IIMR, NBAIR, and SAU) on the efficacy of ecology-based IPM, biological control and low-cost control measures, and on risk and efficacy of insecticides.</td></tr>
<tr><td rowspan="3">Activity 3.1</td><td colspan="3">Review and disseminate knowledge on critical issues to promote ecology-based IPM and biocontrol</td></tr>
<tr><td>Achieved</td><td colspan="2">Yes</td></tr>
<tr><td>Comments</td><td colspan="2">This activity had two components, as follows.
– Document available knowledge on impacts of seed treatments, and on relations between infestations, yield loss and management recommendations, in order to support a review of current recommendations on thresholds and a move towards an ecological IPM decision-making process.
– Review/study the effectiveness of agro-ecological approaches in four states in order to develop recommendations for farmers and DOA.
Both these components were fully achieved. Information was updated regularly by all the stakeholders involved; ICAR-IIMR, NBAIR, NCIPM, SAUs, and DPPQS have documented the available knowledge in order to review and disseminate knowledge on critical issues to promote ecology-based IPM and bio-control.
The selected institute (ICAR-NBAIR) conducted studies on BIPM in farmers' fields. Recommendations were given to farmers by NIPHM, ICAR-IIMR & ICAR-NBAIR; NBAIR also provided the mother cultures of bioagents, while CIPMC state biocontrol laboratories were actively involved in the supply of pheromone bioagents, EPF and microbial agents, ensuring that FAW management was available to farmers at local level.</td></tr>
<tr><td rowspan="3">Activity 3.2</td><td colspan="3">Promote enabling environment for the sustainable management of FAW, reducing risks of pesticides in particular hazardous pesticides and promoting use of biological control</td></tr>
<tr><td>Achieved</td><td colspan="2">Yes</td></tr>
<tr><td>Comments</td><td colspan="2">FAO facilitated partners with regard to the sustainable management of FAW, focusing on the environment and health-friendly strategies, including biological control. A package of practices for the management of FAW in maize and sorghum was widely circulated by DAC & FW in collaboration with ICAR-IIMR, NBAIR and NIPHM, emphasizing IPM and including cultural mechanical and biological control practices of this pest on grain corn, sweet corn, baby corn fodder and silage maize. The biological control of FAW has been promoted by DAC & FW. Concerted efforts will be made by DPPQS to continue these efforts, to conduct capacity-building activities and to produce biocontrol agents.</td></tr>
<tr><td rowspan="3">Activity 3.3</td><td colspan="3">Learn and share experiences and knowledge with Americas, Africa and Asia</td></tr>
<tr><td>Achieved</td><td colspan="2">Partially</td></tr>
<tr><td>Comments</td><td colspan="2">The project facilitated South-South Cooperation exchanges between Indian experts and other countries in Asia and elsewhere, and increased the visibility of India in international workshops and events on FAW. Activities, experiences and successes were communicated through the FAO FAW Portal and the FAO Global Farmer Field School Platform. As a result of the COVID-19 pandemic, the terminal workshop could not be organized.
Experiences and knowledge were shared with America, Africa and Asia. International speakers were invited to the inception workshop, and exposure was given on various aspects of sustainable FAW management through regular virtual workshops, Webinars and training. With regard to monitoring and early warning, FAO's FAW Early Warning and Monitoring System was introduced and the Crop Pest Surveillance and Advisory Project was applied to FAW.
The project emphasized the importance of plant diversity and agronomic management of FAW, and the scaling-up of biological control of FAW. It assessed the state of research of the FAW biological options effective in India, and supported the local and community production of biological control agents, taking into account the experience of the Centre for Agriculture and Bioscience International in the biological control of FAW. The role of KVKs in promoting biocontrol for FAW was assessed and an overview provided of international experience on FAW management.
With regard to rural advisory services and FFS, the project organized FFS on FAW, emphasized the role of NIPHM in training and extension services for the management of FAW and shared the extension network experiences of States on FAW.
A national interactive workshop on "Sustainable management of fall armyworm in India" was organized at NIPHM, Hyderabad.</td></tr>
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Partnerships and Outreach
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