Fall Armyworm:
Impacts and Implications for Africa

Evidence Note Update (Summary Version), October 2018

This publication is a summary of an Evidence Note (*Fall Armyworm: Impacts and Implications for Africa*) published by CABI in October 2018, as part of its Action on Invasives programme. The full report is available at www.invasive-species.org/fawevidencenote2018

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Key messages

- 44 countries in sub-Saharan Africa are now affected by fall armyworm (FAW). Small areas on the north coast of Africa are environmentally suitable but not yet affected. FAW was recently confirmed in India and can be expected to spread to other suitable areas in Asia, including some major maize production zones.
- Farmers in Ghana reported 26% maize loss due to FAW in the most recent season, and in Zambia, 35%. This translates to a national annual loss of around US$177m in Ghana and US$159m in Zambia. This is lower than 2017 estimates but farmers may still be over-estimating yield loss.
- Pesticides are the most commonly used control method although in Zambia over a third of farmers did not attempt control. In Ghana over a third of farmers used biological pesticides, encouraged by government recommendations and subsidies.
- Research and development on FAW monitoring and control is expanding the set of integrated pest management (IPM) tools available. Mortality due to local natural enemies of FAW is reaching high levels in some cases. Managing the pest in maize is the overriding priority as there are few confirmed reports of serious damage in other crops.
- Many organisations are providing advice to farmers using a variety of traditional and novel communication methods with varying objectives. Recommended control methods should be efficacious, safe, sustainable, practical, available and cost-effective. The extent to which these criteria are met varies with the control method and the context in which it is used.

Purpose

The purpose of this Evidence Note is to provide new evidence on the potential impact of FAW in Africa by:

- highlighting new information on the biology of FAW in Africa, as well as important gaps in knowledge
- updating the current distribution maps of FAW
- assessing the socio-economic impact of FAW on affected farmers, and how they are coping with the pest
- updating the economic impact in affected countries
- providing a brief summary of research and development on control methods
- reviewing the type of advice being given to farmers
- making recommendations for sustainable management of FAW

This document makes reference to, but does not repeat the information in the 2017 Evidence Note.

FAW biology

FAW populations in Africa include both the 'corn strain' and the 'rice strain'. Studies suggest that they are most similar to those in the Caribbean and the eastern coast of the United States. Although the strains are named for their relative host preference, in Africa almost all major damage has been recorded on maize. FAW has been reported from numerous other crops in Africa but usually there is little or no damage. At the moment managing the pest in maize remains the overriding priority.

In Africa FAW breeds continuously where host plants are available throughout the year, making it more likely that crops are infested early. FAW is capable of migrating long distances aided by the wind, so it also causes damage in seasonally suitable environments. Evidence on the relative frequency of these two scenarios is scant, but wide scale monitoring and detailed biological studies are addressing this gap. Control strategies may need to be different in the two scenarios.

Studies in Africa show natural enemies (predators and parasitoids) have "discovered" FAW as a new food source, and in some places high levels of parasitism have already been found. This is similar to the situation in low-input farming systems in Latin America.

Distribution and Spread

FAW in Africa

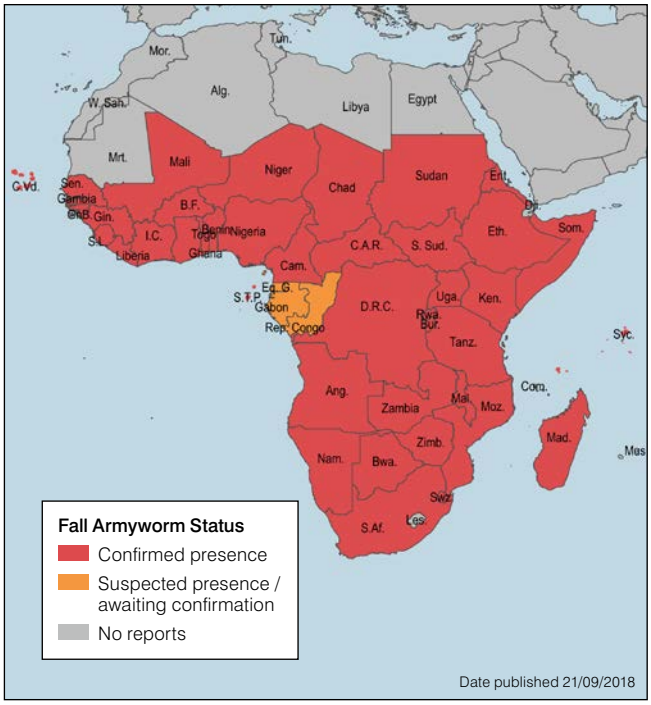
In September 2017 28 countries had confirmed the presence of the pest, with nine others awaiting confirmation. As expected, rapid spread continued and now 44 countries in Africa are affected by FAW (**Map 1**). Its presence is suspected in Equatorial Guinea and Gabon, while Lesotho indicates FAW is not present. So far there are no reports from North Africa, but FAW has reached several Indian Ocean islands including Madagascar.

An updated environmental suitability (climatic) map (**Map 2**) suggests that almost all areas in Africa suitable for FAW are already infested. Light green shading represents low suitability for FAW, yellow shading represents moderate suitability and orange and red signifies the environment is suitable or very suitable.

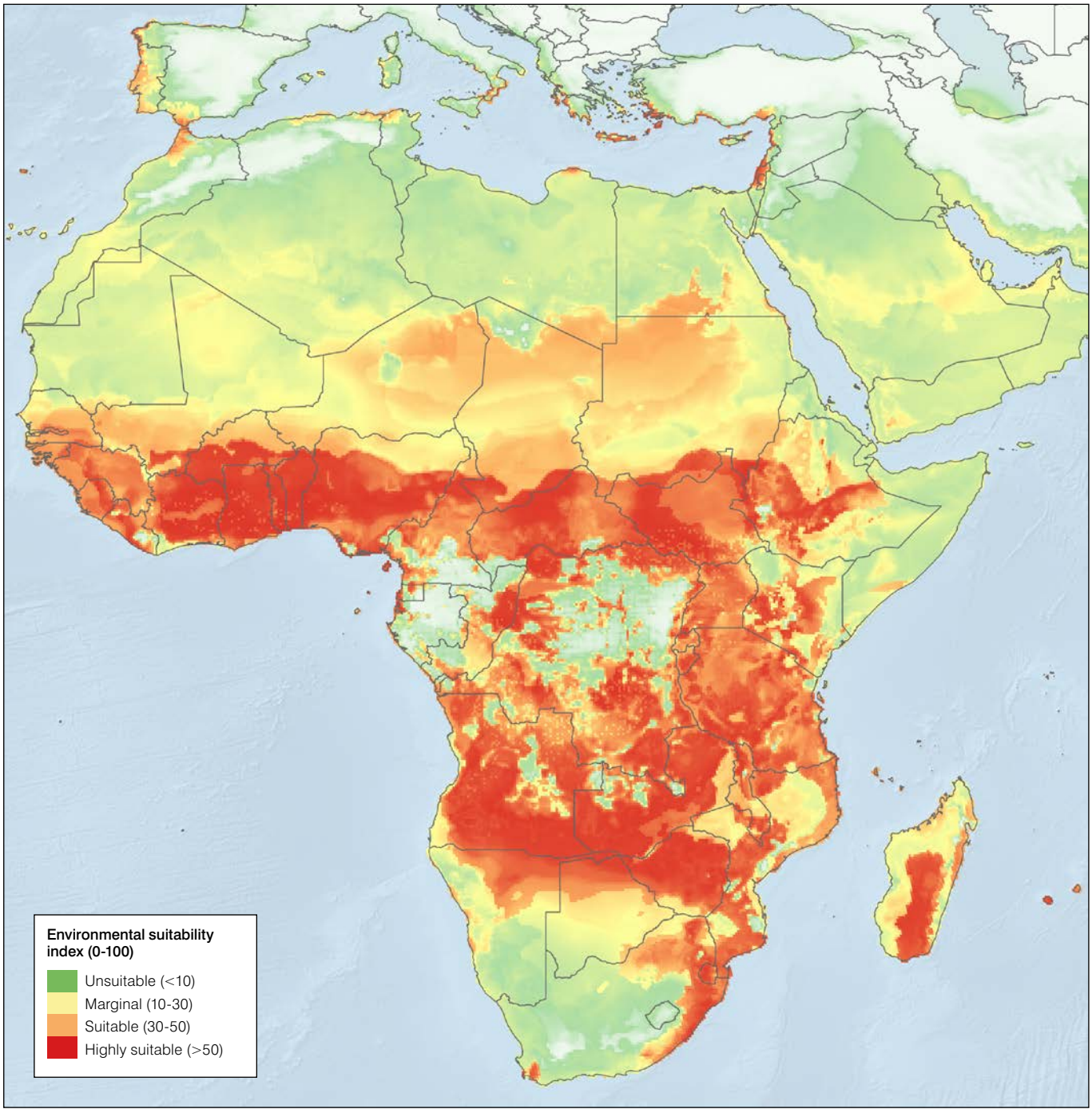
Spread directly across the Sahara is unlikely. If FAW reaches North Africa, it would become a risk to Europe through migration, particularly for the small environmentally suitable regions in southern Europe.

The models indicate mean temperature of the coldest month of the year and intensity of the rainy season are the most important variables for predicting environmental suitability for FAW.

Map 1: Distribution of fall armyworm in Africa (September 2018)



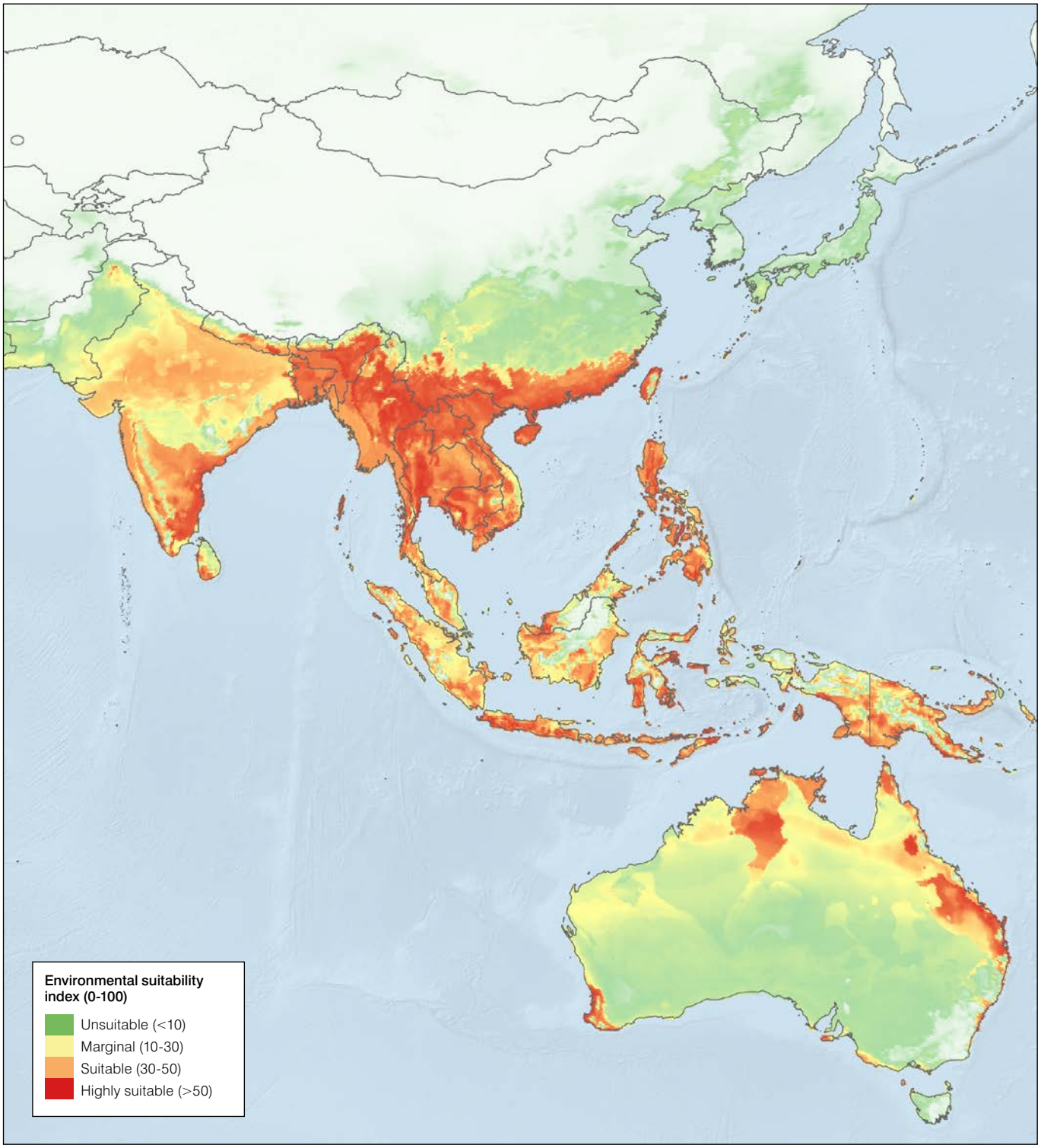
Map 2: Environmental suitability for FAW in Africa



FAW in Asia

In early 2018 FAW was found in Yemen and in July it was announced in India. **Map 3** shows that large areas of Asia are highly suitable for FAW. Some of these areas correspond with major maize-producing zones, and as the pest can be expected to spread rapidly through Asia, countries at risk should prepare response plans immediately.

Map 3: Environmental suitability for FAW in Asia



Impacts in Africa

Yield loss

New household surveys were conducted by CABI and partners in Ghana and Zambia in 2018, to determine farmers' latest assessment of losses due to FAW and their control practices. Over 98% of farmers reported maize to be affected, but only 2-4% reported damage to Napier grass, sorghum or millet.

In Ghana the average maize loss reported by farmers was 26.6% and in Zambia 35%. This is much lower than reported in 2017. Yield loss could be lower due to climatic factors, build-up of natural enemies or improved management. Farmers may also be getting better at estimating FAW damage. A combination of all these factors is likely.

Extrapolating these losses nationally gives an estimate of US$177m lost value of the annual maize crop in Ghana and US$159m in Zambia (prices are lower in Zambia). Most parts of Ghana and Zambia are highly suitable for FAW (**Map 2**), so countries with maize growing in areas less suitable for the pest might be expected to suffer less damage. However, the relationship between environ mental suitability and level of loss has yet to be established.

Farmers' control practices

Applying pesticide is the most frequent control method deployed. More farmers use pesticides in Ghana than in Zambia, but fewer farmers used pesticides in 2018 than in 2017. In Zambia the proportion of farmers using traditional methods or not controlling FAW has increased since 2017. In Ghana the proportion of farmers using no control method has halved.

In Ghana a major change from 2017 is a marked increase in the use of biopesticides. This reflects the country's decision to promote "biorationals" through recommending and subsidising their use. The most common active ingredient used was *Bacillus thuringiensis* (Bt); over half the users had received it free. In contrast, very few farmers use biopesticides in Zambia. A small number of farmers reported using highly toxic WHO Class 1 pesticides.

Table 1. FAW control methods used by farmers in Ghana and Zambia (some farmers use multiple methods)

Control practice	Ghana % (n=488)	Zambia % (n=437)
Pesticides	53.1	42.8
Biopesticides	37.1	1.4
Handpicking eggs and caterpillars	20.5	27.0
Frequent weeding	20.3	0.5
Early planting	19.3	5.5
Manure or fertilizer application	11.7	3.2
Destroying infected plants	4.7	3.2
Application of ash, sand or urea	2.5	14.9
No control practices	14.7	36.5

Trade impacts

FAW was already a regulated pest in Europe before its arrival in Africa, and was regularly intercepted on commodities from Central America. In response to the increased risk to Europe from the establishment of FAW in Africa, the EU instigated emergency measures with effect from 1 June 2018 for a period of two years. The measures cover *Capsicum, Momordica, Solanum* and maize, and require strict controls to be in place in countries to reduce the risk of the pest reaching Europe. In 2017 two consignments from Africa containing FAW were intercepted in Europe, and 17 interceptions have been made in the first eight months of 2018, nine of which were on the specified crops. These levels of interceptions suggest African exporters are managing the situation satisfactorily by including FAW in already established phytosanitary procedures.

Controlling FAW

There is wide agreement that Integrated Pest Management (IPM) is appropriate, though there is debate on the importance of the different elements. The main IPM "tools" in use or being researched are the following.

Monitoring of FAW provides information to support decision-making by farmers and others. At farm level, field scouting scores the percentage of plants affected and can be used to decide whether treatment (such as pesticide application) is worthwhile. However, action thresholds are yet to be determined in Africa. Pheromone traps are being used to monitor FAW, although in the US there is a poor relationship between trap catch and population size and different brands of pheromone have different attractiveness. FAO has developed an Android app (FAMEWS) for recording field scouting and pheromone trap data, viewable on a public platform (**tiny.cc/FAMEWS_maps**). Research on remote sensing, automatic counting of trap catches, image analysis of insects and damage, and radar will all improve monitoring and contribute to understanding FAW biology, as well as provide opportunities for forecasting. Work on African armyworm showed that monitoring and forecasting is only useful if it increases the expected value of specific control decisions.

Farmers are experimenting with traditional pest control methods as well as trying new ones, including the use of charcoal, ash, chilli powder, paraffin, tobacco, detergents and salt solution. Ingenious ways of encouraging natural enemies have been reported. Some organisations are conducting trials on these methods which have the benefit of being low cost and locally available.

Pesticides are being used by many farmers and are recommended by governments. Many are effective if applied correctly, but are often used without appropriate safety precautions, so recommending even WHO Class II pesticides is potentially dangerous. Some farmers are illegally using WHO Class I chemicals which are highly dangerous. Reports of pesticides being ineffective are probably due to inappropriate use rather than pesticide resistance. Seed treatment is being promoted, which can protect the crop for up to several weeks in favourable conditions.

Biopesticides (including botanicals, biochemicals and microbial insect pathogens) that are potentially suitable for FAW control in Africa have been identified in a CABI survey of registered biopesticides in 30 countries. Out of 50 active ingredients (AI), 12 are considered effective against FAW and are already registered for other pests. Safety concerns with four of these require assessment. The remaining eight AI should be prioritized, and field testing is in progress for several including insect viruses, *Bacillus thuringiensis* (Bt), neem products and mating disruption using pheromones.

Biological control offers immediate and longer term potential. Several indigenous natural enemies (predators and parasitoids) have been discovered attacking FAW eggs and larvae, with up to 70% parasitism reported (IITA, icipe, CABI and others). Introducing natural enemies to Africa from the Americas (classical biological control) is another option and research in Latin America (CABI) and Africa (IITA) is in progress. A parasitoid originally identified as a candidate for introduction has been found to be already present in Africa, highlighting the importance of natural enemy surveys.

Agronomic and cultural practices can reduce the likelihood or severity of FAW infestation. Crop diversity is beneficial and there is evidence that intercropping maize with legume crops (beans, soybean, groundnut) reduces damage. The use of companion plants (repellents and trap crops) has also been reported to reduce FAW damage in Africa. Work is required to ensure companion plants are not weedy and can be grown cost effectively.

Insect-resistant maize populations have been identified by CIMMYT, and five hybrids look promising and may be available within two to three years. AATF has been working on genetically modified maize with bacterial transgenes conferring pest resistance. Preliminary results show partial but significant control of FAW. So far few African countries have legalised the use of any genetically modified crops.

FAW advice and information

Advising farmers

When confronting a new problem like FAW, farmers need prompt information and advice, particularly on methods to avoid or reduce infestation. In principle any recommendation for a control method should be based on the following considerations.

Efficacy Results from controlled trials in an appropriate context are desirable, though not always available.

Safety Even registered products can be hazardous to human health without precautions. Some practices (e.g. some plant extracts) not requiring registration can also be hazardous

Sustainability Non-target organisms such as pollinators, natural enemies and other organisms may be affected, and new problems (such as pesticide resistance) may be created.

Practicality Some methods may be impractical for some farmers, such as those requiring elaborate safety precautions.

Availability Regulated products may not be widely stocked even when registered, and unregulated inputs for some control methods may not be easily available.

Cost-effectiveness At the simplest level the cost of control must be less than the value of crop loss avoided for it to be worthwhile. Opportunity and other costs may need to be considered.

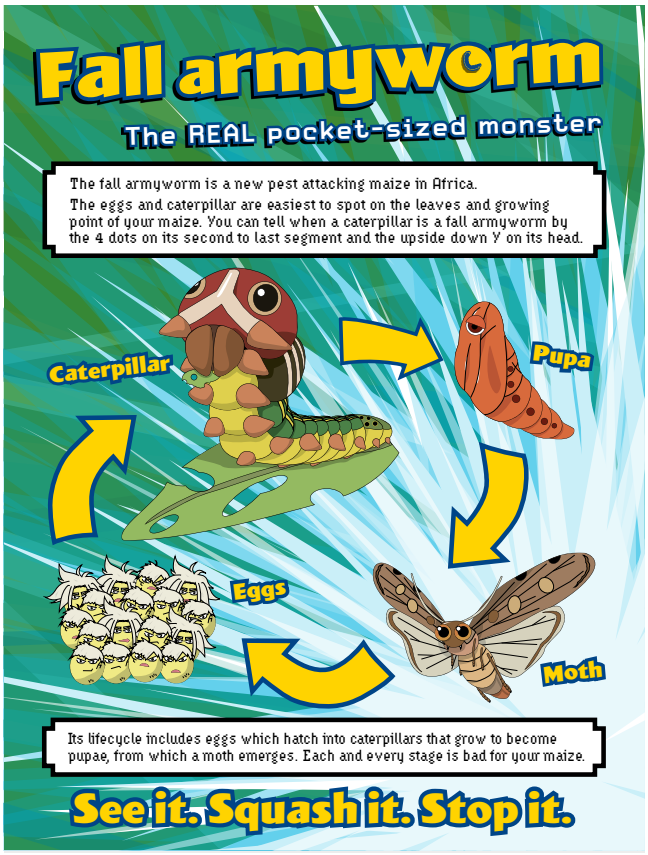
In practice many of these criteria are context specific, so recommendations and advice are unlikely to suit all farmers in all situations. This highlights different underlying approaches to changing farmers' control practices. The linear "transfer of technology" approach emphasises prescriptive advice on the use of new technologies. Participatory approaches emphasise educating and empowering farmers to use information and experience to make their own choices. Both approaches have advantages and disadvantages.

Multiple communication channels are being used and tested for communicating with and advising farmers on controlling FAW. These include traditional and innovative ICT-based systems. Again, each has advantages and disadvantages in relation to the quality and complexity of information that can be communicated, and the cost per recipient.
A combination of approaches is likely to provide the most cost-effective outcomes.

Information for other stakeholders

Much information on FAW that does not directly target farmers has been collated and published, including manuals produced by CIMMYT, USAID and FAO. These and many other materials for farmers, researchers and other stakeholders are available through CABI's fall armyworm portal (**www.cabi.org/isc/fallarmyworm**). CABI is also coordinating the development of a policy toolkit for strategic communication during pest outbreaks.

Figure 1: A FAW awareness poster aimed at youth



Recommendations

Many stakeholders contribute to the management of FAW, as envisaged within the FAO partnership framework and the newly launched R4D consortium. Recommendations are made for four key groups.

Those responsible for **national coordination** of ongoing responses to FAW should:

- Ensure the voice of different stakeholders, especially smallholder farmers, is heard
- Monitor the FAW situation, particularly crop loss and control practices, to provide evidence for national decisions
- Use any subsidies to encourage the use of low risk control methods rather than pesticides
- Learn lessons from tackling FAW that can be applied to other invasives

When making and disseminating information and advice, **Advisory Services** should:

- Use a combination of both traditional and novel communication methods
- Tailor messaging to specific target audiences
- Consider efficacy, safety, sustainability, practicality, availability and cost effectiveness when recommending control practices
- Encourage farmers to:
  - Maintain plant diversity through intercropping and habitat management
  - Avoid practices which kill natural enemies of FAW
  - Observe and monitor fields regularly after germination
  - Experiment with different control practices
  - Refrain from intervening as soon as leaf damage is observed

Regulators should:

- Maintain regulatory credibility by providing emergency/temporary registration for government-recommended control products
- Work with industry associations to identify and stop companies selling unregistered and/or dangerous products
- Within the existing legal framework, expedite registration of lower risk products
- Continue efforts to regionally harmonise pest control product regulations

Researchers should:

- Test and validate commonly used control methods
- Develop simple and robust action thresholds based on FAW damage levels
- Determine why control actions are successful or not (including pesticide application)
- Monitor FAW natural enemies and identify practices that conserve and enhance the mortality they cause
- Identify opportunities for establishing local enterprises producing bio-inputs
- Continue research on the use of host plant resistance and classical biological control
- Continue research on FAW biology and ecology, with the aim of improving control decisions by farmers and other stakeholders
- When developing and introducing new control practices, consider safety, sustainability, practicality, availability and cost effectiveness for smallholder farmers.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How to manage...
Fall armyworm
Fall Armyworm (FAW) is a migratory pest which is causing severe damage to maize, rice, pastures and over 80 other plant species.
PREVENT
MONITOR
ACT
CAUTION
For more info visit: www.plantwise.org/fallarmyworm
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