



Fall armyworm management: lessons learnt from Ghana

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Summary

The invasive pest, fall armyworm (FAW) was confirmed to be in Ghana in 2016. Stakeholders, including CABI, worked to support the development of a national FAW management plan. A review of the management plan implementation was undertaken using outcome harvesting, a Sprockler inquiry and key informant interviews. Results showed evidence of stakeholder collaboration, leading to increased public awareness of FAW and related management practices, and more coordinated research into low-risk management options. Key factors for the success of the FAW response were: establishment of the multidisciplinary taskforce, with common goals and ownership; mobilization of financial, human and material resources at national and district levels; effective coordination and communication, limiting duplication of efforts by different actors; farmer sensitization to identify and manage FAW and other pests. Steps to ensure future preparedness include: implementation of the National Invasive Species Strategy and Action Plan (NISSAP); establishment of a standing taskforce and emergency fund to address new pest outbreaks; improved monitoring and surveillance especially at borders and ports of entry; strengthened research capacity especially in pest risk analyses; and development of emergency response guidelines for future outbreaks.

Key highlights

- An initial slow response to the FAW outbreak was mainly due to inadequate funds and lack of knowledge of the pest.
- Once the impact of FAW became apparent, funding was released and the response effectiveness increased.
- Stakeholders at central level (e.g. central government officials, researchers, media, NGOs) considered key response success factors to be collaboration through the multidisciplinary taskforce, knowledge sharing, and effective planning, coordination, and communication.
- Stakeholders at the local level (e.g. local government officials, extension workers, local leaders, farmers) considered the pesticide distribution scheme and the information shared through the communication plan as contributing to the response success.
- Future preparedness measures should be put in place to ensure quick responses to new pest outbreaks in the future.

Context

The invasive pest, fall armyworm (FAW; *Spodoptera frugiperda* J.E. Smith), was confirmed as present in Ghana in 2016. In response to the FAW outbreak, the Plant Protection and Regulatory Services Directorate (PPRSD) of the Ministry of Food and Agriculture (MoFA), worked with CABI and other stakeholders, to support a number of FAW-specific activities. A national multi-stakeholder taskforce was created to coordinate the FAW response. A FAW management plan was developed that focused on four priority areas: coordination and collaboration; awareness-raising; monitoring and surveillance; and research and management. The national plan aimed to ensure coordinated efforts between public, private, and civil society organisations in the management of FAW.

This study aimed to identify the main lessons from and strengths of the FAW response, to inform future preparedness and ask 'How ready are we for a similar challenge in the near future?'. The inquiry aimed to:

- discover what worked well in the FAW response
- identify areas of weakness and opportunity for strengthening future invasive response efforts
- identify what is needed to sustain the FAW response interventions in Ghana.

The FAW response occurred within the policy and project framework found in Ghana at the time, as well as the food security threat posed by the FAW outbreak. The government flagship project, Planting for Food and Jobs (PFJ) aimed to increase food production and farm incomes, with maize as a target crop. The PFJ drove government actions against FAW as there was a high likelihood that the FAW infestation would erode expected gains from the project.

"The Government had just embarked on a massive agricultural transformation agenda by rebranding agriculture and increased subsidy support for farmers to enable them to use improved inputs. In the first year of the programme, the FAW outbreak occurred in the sub-region. To prevent the devastation of the crop fields by the pest and undermine the programme, the Government immediately established a national committee to address the problem and curtail its spread and negative impact on crop yield and farmers' incomes." - Central government official

The government would still have taken action due to the economic and food security threat posed by the FAW infestation on maize, which was estimated to cause an annual loss of US\$ 177m to the value of the maize yield (Rwomushana et al 2018). The government supported the distribution of pesticides to a total of approx. US\$11.6 million between 2017 and 2020.

“The FAW pest invasion was a food security threat to the nation and it was Government’s responsibility to address the situation from management, human resource and financial perspectives” – Central government official

A number of key policies were also relevant to the FAW response, including at sectoral level, both Food and Agricultural Sector Development Policies (FASDEP II and FASDEP III) which contain policy objectives on food security and emergency preparedness to guide the management of pests and diseases incidences affecting agricultural production and productivity. The current FASDEP III includes promotion and support for disease surveillance and early warning systems to prevent the outbreak of scheduled diseases. A key investment area in the Ghana Agricultural Investment Plan (2018-2021) targets promoting access to plant disease prevention and control measures. A key challenge to be addressed in the Ghana National Climate Change Policy of 2014 is the increasing number of alien pests and diseases occurring as a result of changes in temperature and humidity.

Government institutions including PPRSD are responsible for ensuring compliance with the SPS measures and protecting Ghana’s biodiversity against invasive pests. The directorate was re-established by the Plants and Fertilizer Act, 2010, which states PPRSD’s responsibilities include:

- inspecting consignments of plants and plant products to prevent the introduction and spread of pests and issuing phytosanitary import permits and certificates
- ensuring phytosanitary security of exports
- carrying out surveillance for occurrence, outbreak, spread and control of pests
- conduct pest risk analyses

The most current policy document is the NISSAP (2020 – 2030), which CABI and the Environmental Protection Agency collaborated with other relevant stakeholders to formulate. (It is in press.) The formulation of the NISSAP arose from the fight against the FAW and the experiences learnt, and includes strategies to counter pest invasions, sets out institutional responsibilities, and the need for inter-institutional collaboration and cooperation in fighting invasive pests.

What we did

Multiple methods were used in this inquiry. Outcome Harvesting, which focuses on identifying, describing, verifying and analysing outcomes, was used to gather documented outcomes from a number of source documents (FAO, 2017; Feed the Future, undated; Agboyi et al 2019; CABI 2019). We harvested outcomes that showed a change in the behaviour, relationships, actions, activities, policies, or practices of an individual, group, community, organisation, or institution in relation to response to FAW invasion in Ghana. After a thorough review of documents, reported outcomes were categorised under: (i) research and management; (ii) surveillance; (iii) awareness; (iv) collaboration; and (v) policy.

These harvested outcomes formed the basis of the Sprockler questionnaire, which was used to gather data and information to validate the harvested outcomes. Sprockler is a methodology and an online platform that allows for collecting, processing, analysing and visualising quantitative and qualitative data. It is designed to evaluate complex contexts that involve many different stakeholders. Sprockler has a strong narrative component and focuses on collecting stories that explain why change has happened and how people experienced it. Key informant interviews were conducted to deepen the insights coming from the harvested outcomes and the outcome validating results of the Sprockler questionnaire.

Information was gathered through questionnaires and interviews with government officials (national, district and local levels), NGOs researchers, farmers and mass media practitioners. The various stakeholders interviewed played different roles in the response, and subsequently their perceptions of the effectiveness of response varied. However, the mix provides pointers of what worked or did not work that can guide future responses. Face-to-face, online, and phone interviews were conducted, with 132 respondents including those from central government (23), local government (58), farmers (33), researchers (8). Respondents came from 61 different districts. Questions focussed on the changes at institutional and individual levels in the delivery of FAW management plan, describing how the change happened and what ought to be done to sustain the change. There was only one response related to policy: therefore, this response was not analysed separately. Percentage responses were calculated based on the number of responses for each question. Bipole responses were scored, through Sprockler, on a scale between 0 and 1. The most positive or negative choices were classed as ≤ 0.25 or ≥ 0.75 on that scale.

What was achieved?

Research and management

Initially, formal management strategies from Central and South America, where FAW is native, were used as the basis of Ghana's FAW management plan. They provided information on pesticides and natural enemies of FAW, as well as knowledge of indigenous practices such as the use of soap and wood ash. Farmers initially used locally developed solutions, such as water with detergent, neem leaf extracts or pesticides that worked on other pests, before government recommended practices were shared. They used the government freely supplied pesticides when they became available, since without the free supply, they could not all afford the pesticides.

"During the initial stages of the FAW infestation, farmers attempted to control the pest with their own developed innovations. Some farmers used soapy (detergent) solution to spray on the FAW. However, when the soapy solution was too much, it harmed the plants. Others used neem extracts in solution. Some others also used some of the agro-chemicals used against other pests on trial-and-error basis." - Farmer

A change in management methods was reported as the outbreak continued, which was mainly due to availability of more information on FAW management techniques (Figure 1), as well as improved surveillance.

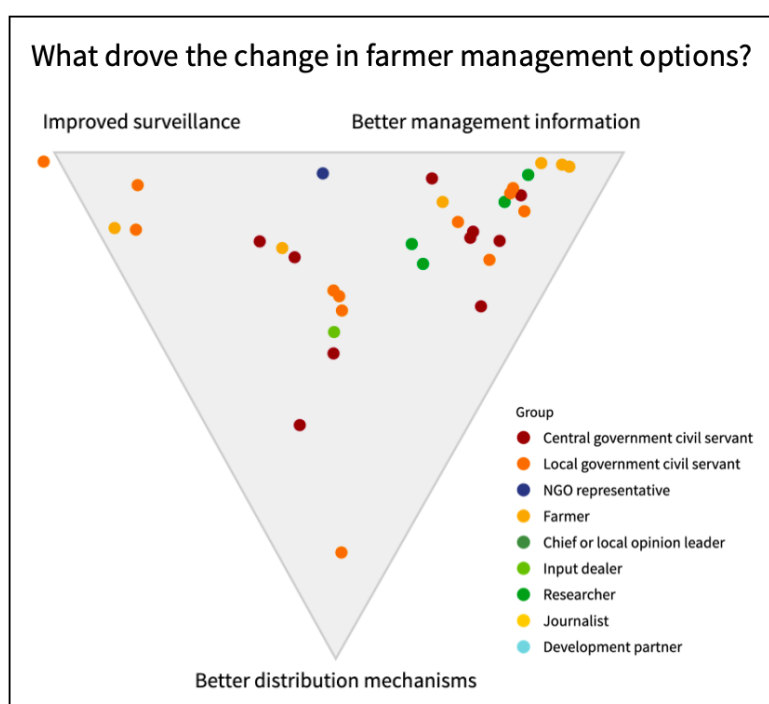


Figure 1: Reasons for change in farmer management practice (Tripole, n=37)

"I think [in] the beginning we, as in staff and farmers, abused the application of pesticides in attempting to control the pest. All types of chemicals were sprayed not thinking about beneficial insects and other natural enemies. In the future, we need to avoid panic reactions." - Local government civil servant (regional officer)

At the time of the study, 89% of respondents felt knowledgeable and informed about the management of FAW in Ghana, 59% felt involved and 48% felt empowered. Fifty nine percent of respondents believed that research played an important role in finding effective management solutions to the FAW in Ghana, while 27% thought research did not play a role at all (Figure 2).

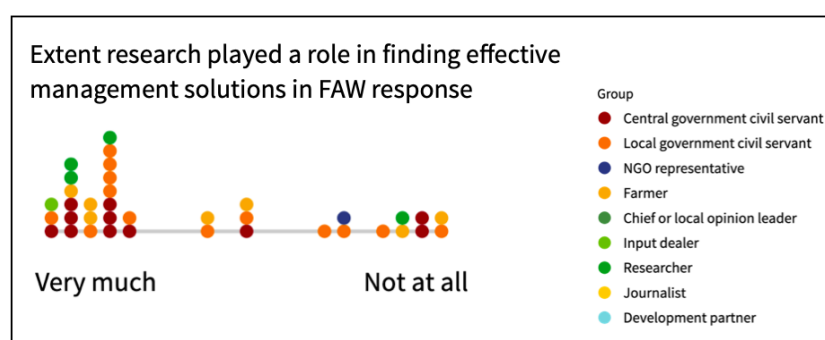


Figure 2: Role of research in effective management solutions (Bipole, n=37)

Finance and personnel played the biggest part in enabling the research efforts in the FAW response (Figure 3).

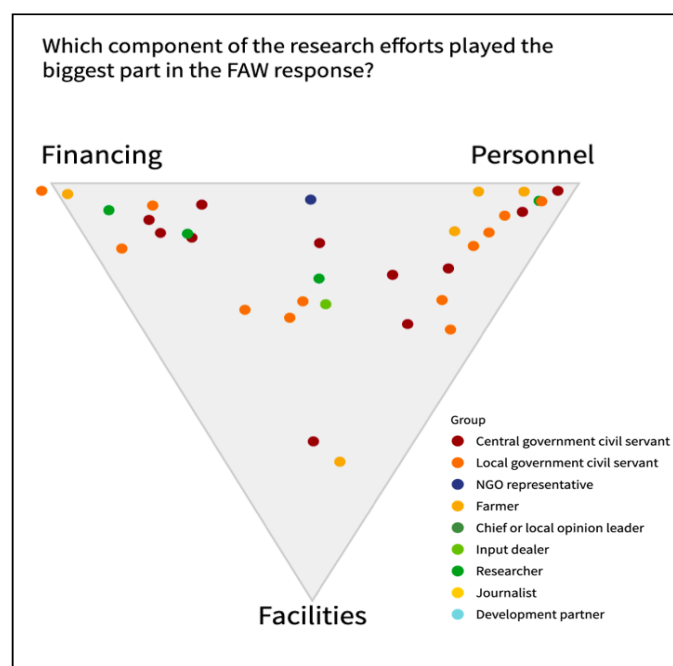


Figure 3: Enabling factors in the research and management response (Tripole, n=37)

Surveillance

When FAW was detected initially, surveillance processes were not very clear, but after the initial response, and after intensive training and sensitization activities took place, and early warning systems were put in place, the monitoring and surveillance of FAW became easier. Forty three percent of respondents thought that the monitoring/surveillance of FAW was very effective, through methods such as scouting, and the use of pheromone traps. However, 26% of respondents considered the monitoring/surveillance to be very ineffective (Figure 4). Potential reasons for the perception of the limited effectiveness of monitoring/surveillance included delays in the initial government response to the outbreak, the lack of resources for monitoring in certain areas, and the need to cover more remote areas.

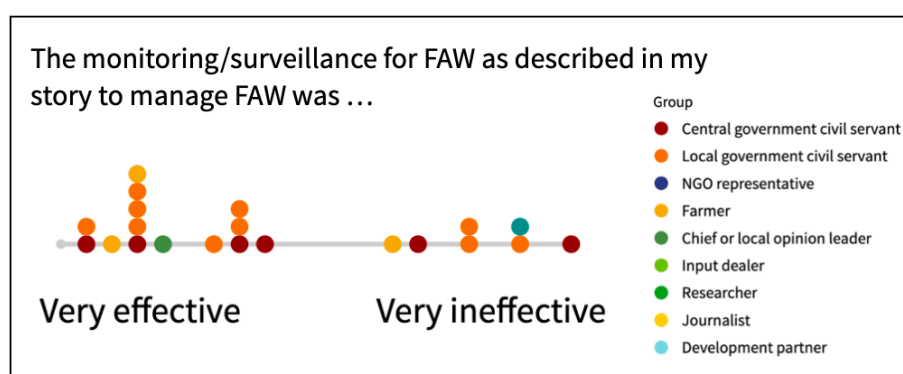


Figure 4: Effectiveness of monitoring and surveillance (Bipole, n=19)

Awareness

Awareness-raising activities for farmers and communities included programmes run by plant doctors and the Department of Agriculture to train farmers and agricultural staff on the identification, prevention and management of FAW. These included plant clinics, group meetings, home and farm visits, training of trainer sessions, or farmers' fora. They were supported by tools such as flyers, posters, booklets, and radio broadcasts. Farmers stated that the awareness programmes enabled them to respond to FAW through recognizing the different stages of the pest, how to detect its presence and how to report on FAW with reliable data. The cooperation between the different actors involved, such as farmers, government institutions, chiefs, assembly members, unit committees, input dealers and opinion leaders ensured the spread of the awareness messaging. The support of international organisations such as USAID, GIZ, and FAO also facilitated this wider awareness-raising.

Most respondents (97%) felt knowledgeable and informed, many felt empowered (57%), involved (49%), and prepared (38%) while some felt hopeful (18%) after taking part in the FAW awareness activities (Figure 5). This suggests that the awareness campaign achieved the key aims of increasing knowledge and preparedness, as well as enabling farmers and others to feel in control of taking action against FAW on their farms.

"Before the meeting most of us (farmers) were confused about what exactly the Fall Armyworm looked like, its stages of growth, monitoring and control. The Agric Extension Officer on the said day came with flyers and posters illustrating the Fall Armyworm, it's stages of growth and control and explained them to our understanding." - Farmer



Figure 5: Feelings about awareness creation activities (Multiple choice. N=65)

Thirty nine percent of respondents (farmers and local government civil servants) thought that the awareness creation was very sufficient, while 11% thought awareness creation was not sufficient (Figure 6). A senior reporter of the Ghana News Agency elaborated that he

considered the communication plan on FAW to be very effective, as the media had the chance to go into the field with researchers and report directly on evidence. In addition, multiple channels were used, such as e-mailing, WhatsApp platforms, seminars, field visits, newspapers and flyers. It was critical that the media were involved as a stakeholder from the beginning of the process.

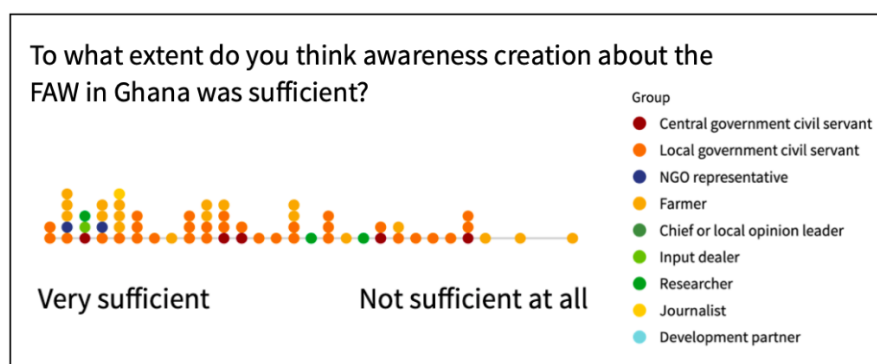


Figure 6: Sufficiency of awareness creation (Bipole, n=62)

Pest infestation response information must be timely to get to the farmer so that the farmer can act in time. Results show that 57% of respondents felt that the information about FAW was received in good time while 7% of respondents reported that the information was received much too late (Figure 7).

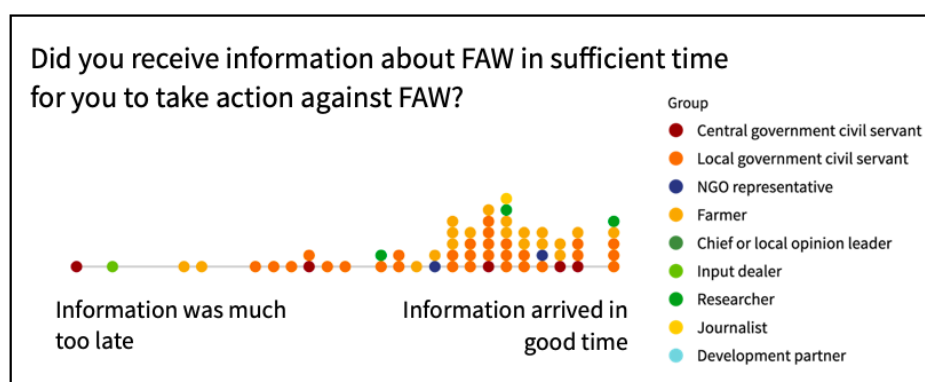


Figure 7: Timeliness of awareness-raising (Bipole, n=60)

Respondents ranked the activities they considered most effective in creating awareness in order of importance or influence (Figure 8). Training (54%) and seminars by extension (32%) were considered the most useful awareness activities, while media activities (52%) and symposia (33%) were considered the least useful awareness activities. This suggests that while general information shared through media channels (radio, newspapers etc.) was useful, most farmers and local government officials preferred more interpersonal means of communication, where presumably there was more opportunity for interaction and asking specific questions, through which additional knowledge was gained.

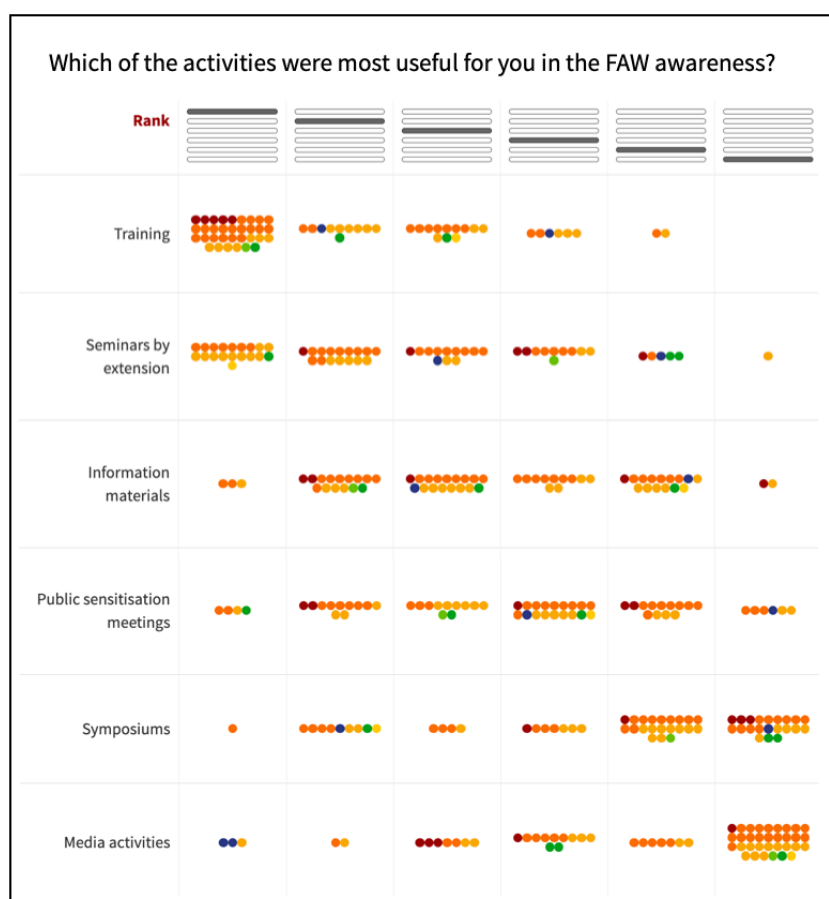


Figure 8: Ranking of most useful awareness activities (Ranking, n=63)

Collaboration

Examples of collaboration included that between government officials and farmers to update farmers on FAW and how to manage it, between government officials and researchers to learn more about prevention and management options, and between different government entities such as PPRSD, agricultural extension officers (AEOs) and plant doctors. Eighty five percent of respondents felt that the collaborative efforts made them feel empowered, 79% felt involved, 63% felt prepared, 27% felt hopeful and 12% felt inspired (Figure 9). These positive responses suggest that one of the key aspects of the response, the engagement of many stakeholders, was effective in ensuring that stakeholders at all levels felt they were part of the response.

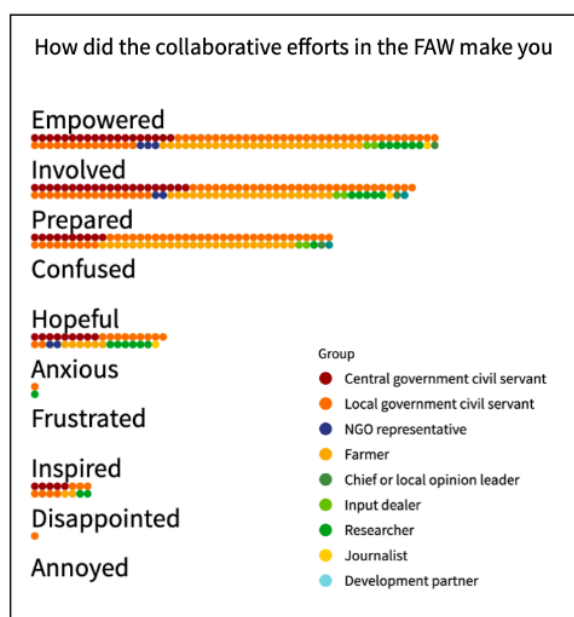


Figure 9: Feelings of collaborative efforts FAW response (Multiple choice, n=130)

Sixty one percent of the respondents thought the collaboration between the different stakeholders in the national response to FAW strengthened enormously from the start of the intervention (Figure 10). This suggests that the inclusive approach was effective, and enabled strong collaboration between different stakeholders that may not previously have worked together.

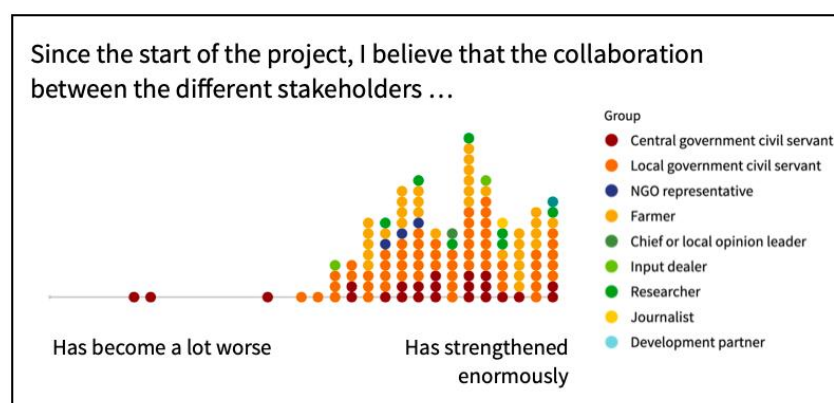


Figure 10: Strengthened or worsened collaboration (Bipole, n=129)

The commitment of those involved was the key factor for increased collaboration (Figure 11). Civil servants from the central government considered commitment and clear benefits as the main elements for successful collaboration, and researchers considered trust and commitment to be critical.

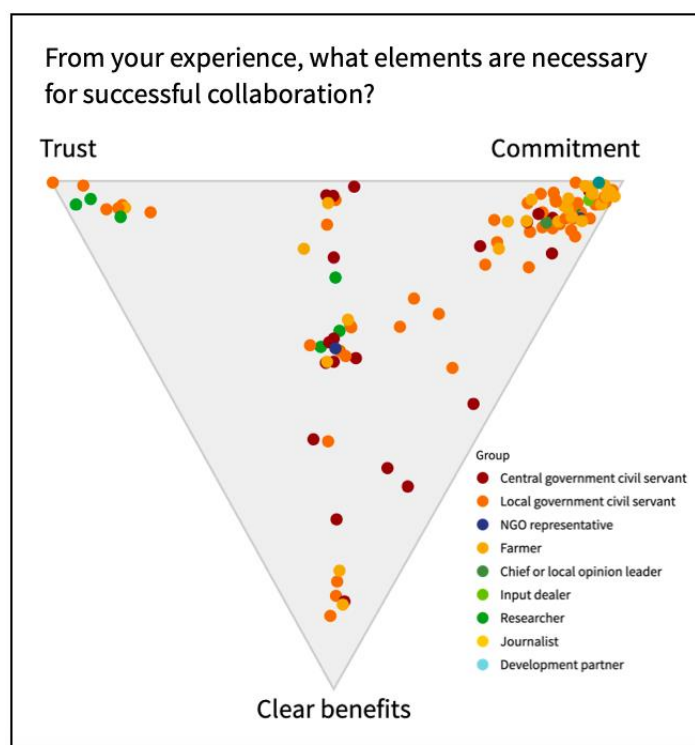


Figure 11: Key conditions for collaboration (Tripole, n=126)

Lessons learned

Success factors

Most respondents stated that increased collaboration and communication (Figure 12) was the key factor in the changes in the FAW response, sometimes in combination with the formal taskforce and shared goals and ownership. The increased collaboration ensured that each actor focused on their strengths, limiting duplication of interventions and ensuring that each actor minimised the weaknesses of other partners. However, the perceived importance of these factors varied by stakeholder, based on the role they played in the FAW response, or their general mandates. Policy actors considered the taskforce and its multidisciplinary teams to be important, as was the mobilization of financial, human and material resources, particularly those to purchase and distribute chemicals. Researchers stated that collaboration between state institutions, farmers and international partners was a factor in the response success. It is apparent that not all respondents were aware of the task force, especially those that did not work at a central government level.

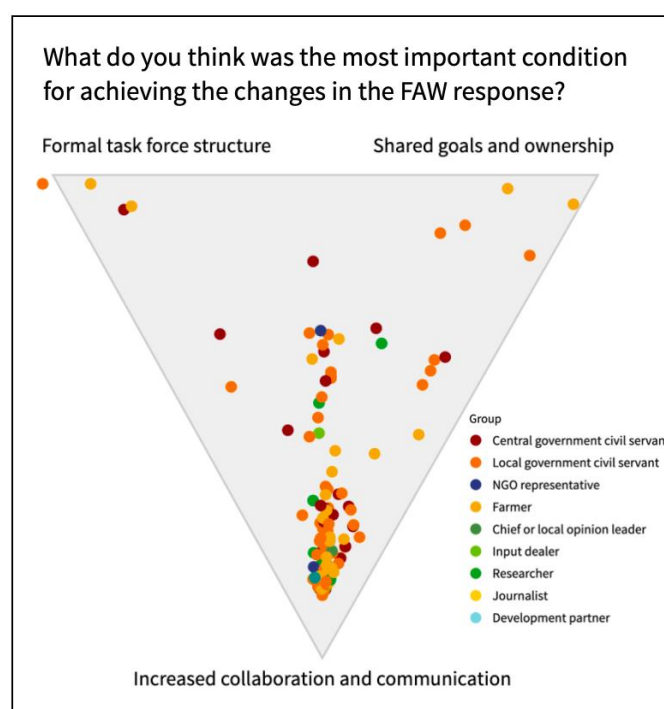


Figure 12: Important conditions for achieving change (Tripole, n=127)

Other success factors included effective planning and coordination; continuous monitoring and management; farmer sensitization and training, including the technical capacity building of civil servants and farmers to be able to identify and manage the pest; and the district level structures put in place including the use of community spray gangs.

Suitability and effectiveness of the intervention

Sixty five percent of respondents considered the interventions to have been exactly what was needed (Figure 13). The central government's response was seen by some as a fire-fighting, rather than a systematic approach initially. Key informants stated that the organised response improved with the taskforce establishment, and the task force was key in facilitating that response. One researcher clarified that whereas the general response appeared slow, the government quickly set up the multi-stakeholder meeting, which formed the start of a coordinated and collaborative response that was considered effective by the informants.

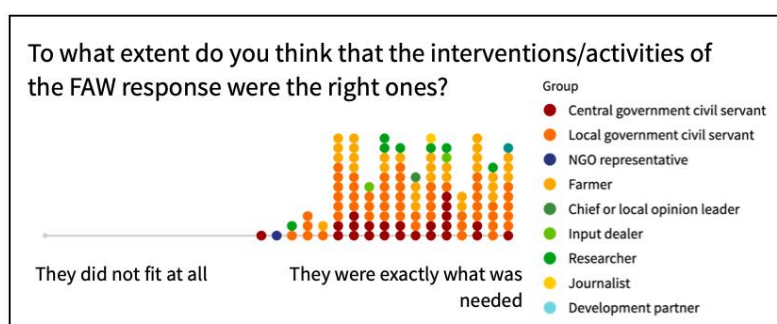


Figure 13: Suitability of interventions (Bipole, n=120)

Fifty seven percent of respondents considered the response very effective due to:

- Swiftiness of agricultural officers' response to farmers' reports of FAW
- Effectiveness of training of agricultural and extension officers, and farmers
- Awareness campaigns for farmers and the public through different media channels
- Quick procurement of a variety of agro-chemicals, and their (free) supply to farmers
- Enhanced stakeholder participation, especially of farmers and development partners
- Multi-stakeholder collaboration and formation of taskforce
- National budgetary support and provision of funds to agricultural and extension officers
- Sponsored research into FAW management

"Their response was very effective because in all seasons throughout the year, chemicals were procured and distributed to the districts which really helped the farmers to combat and control this FAW, even though they were not enough for everyone." - Local government civil servant (Agricultural extension officer)

"At least I could boldly say that based on the efforts made by the Central government I was able to combat the pests when they invaded my farm." – Farmer

Despite this effectiveness, some thought more was needed to ensure continued successful management of FAW, such as the development of local maize varieties that are resistant to FAW. The main complaint was that chemicals did not always arrive on time at all locations, or in enough supply, to adequately assist farmers to manage FAW. Some chemicals were close to their expiration date; there was a requirement for more training on how to apply the chemical products, especially for farmers not used to using chemicals for maize cultivation; there was confusion on who leads the programme; and a lack of spraying gangs in local communities.

Limiting factors

Lack of funding was the main factor limiting the effectiveness of the interventions. Government funding was provided late and coverage was not as complete as expected. Policy actors and development partners recognized that lack of funding was initially a challenge, but that this was overcome. One farmer shared that due to limited funding, the provision of agricultural extension services in various municipalities and districts was limited. The AEOs could not visit all farmers, especially those in remote areas. The farmers who consequently benefitted most were those who were closer to the AEOs' offices.

Lack of funding was also observed by researchers and because of this, awareness and research activities were delayed. Funds were expected from the central government, but were not received, so they had to rely on internal funds until substantial funds were received from donors, such as AGRA, CABI and GIZ. Lack of funding also affected effective coordination of research efforts on a regional scale, as the infrastructure, including equipment and supplies, were not the same across the country. The direction of research was also affected by the lack of funding, as funding agencies influenced what kind of research should be carried out.

Another factor limiting the effective implementation of the response was that not all farmers were able to purchase agro-chemicals, and were not able to fully adopt the innovations being shared by the research institutions. There was a lack of knowledge at the farmer level in the initial stages, leading to the misappropriation of chemicals and a preference for free chemicals.

In some cases this was due to limited extension coverage and inadequate sensitization on FAW.

Initially, farmers and researchers were not sufficiently consulted, though this was addressed. The late inclusion of farmers led to a half-hearted commitment to the implementation initially, though this could also be due to the present organisational structure of the MoFA.

“One may also trace this problem to the present organizational structure of the Ministry of Food and Agriculture, which has the Department of Agriculture under the district assemblies and therefore under the Ministry of Local Government. There is a disconnect in the policy implementation at the district levels. Ideally, MoFA, which has the national and regional organs should maintain them all the way to the districts.” - Farmer

One development partner mentioned the slow pace of policy decision-making on the use of integrated pest management (IPM) led to increased synthetic chemical use and low use of bio-rationales, and stated this was an obstacle to overcome in the implementation.

Sustainability

Thirty seven percent of respondents think it is very likely that the changes in FAW response will still be there in five years' time, while 19% of respondents think this is not likely (Figure 14). The majority of those who think that the changes will not last are farmers, who possibly expect that in the long term they will no longer be supplied with free pesticides, which, for them, was a key element of the current response, or they might expect that future outbreaks will require other management techniques. All researchers and journalists who responded, who are aware of the efforts being undertaken to find long-term sustainable solutions to managing FAW, think that the changes will last.

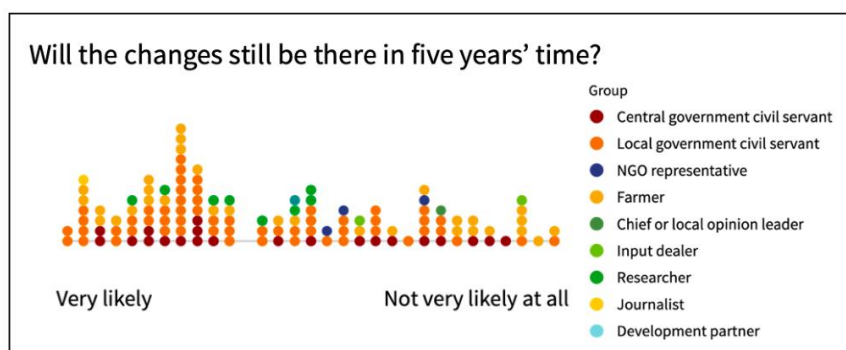


Figure 14: Sustainability of changes in FAW response (Bipole, n=124)

Respondents stated that they felt well prepared to address a similar challenge to FAW in the future (Figure 15), as they know the best steps for a quick effective response. Early warning systems and identification methods are in place, as are surveillance systems to monitor progress. They are more experienced in dealing with such outbreaks, enabling a shorter management response time from pest identification, and know that collaboration between different partners has been set up. The respondents who do not feel ready, felt that there is insufficient funding and a lack of the required logistics to address another pest outbreak.

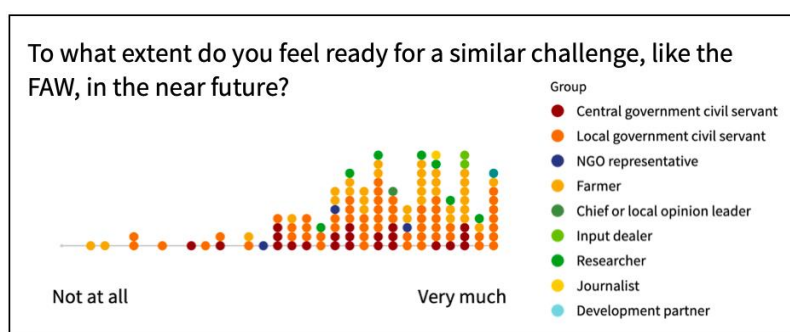


Figure 15: Readiness for similar challenge in the future (Bipole, n=125)

The way forward

Requirements and advice for future invasive pest responses

Funding, knowledge and skills, and collaboration and communication were almost equally considered critical for future responsiveness (Figure 16). Local government civil servants considered funding as the most important requirement, potentially reflecting the challenges they face in securing sufficient funding to implement their duties. Knowledge and skills, additional funding and increased collaboration are required in all of the key response areas. In addition, respondents identified specific areas that require further development.

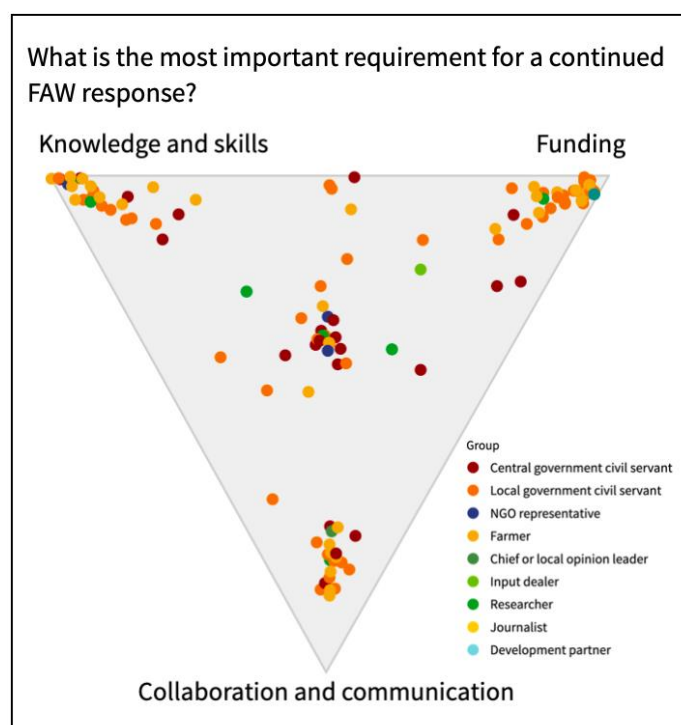


Figure 16: Requirements for the future (Tripole, n=126)

Research and management

Research activities to generate long-term solutions and evidence-based planning processes are critical. Strengthened collaboration and communication between field staff and researchers, as well as pest and disease experts from other countries, is needed for a sustainable response plan. Continuous research and strengthened research knowledge and skills are necessary in many areas including: risk assessments for emerging and new pests that are likely to enter Ghana, and their possible routes of entry, considering a changing climate; use of local biorationals; and monitoring and control systems. The use of IPM measures should be promoted, farmers should be trained to use chemicals safely, including using personal protective equipment, and proper handling and disposal of chemicals.

Surveillance and monitoring

The key to an effective response to invasive pests is an early warning system. Surveillance is a necessary function that has to be performed rigorously and regularly. Surveillance networks, with strong communication across the network, are needed at the borders and in-country for early detection and rapid response, with PPRSD staff, farmers, plants doctors, AEOs trained and carrying out surveillance activities. There is a need to build the capacity, knowledge and skills of quarantine officers in the identification of invasive species, including through regular refresher courses, and improve quarantine and phytosanitary measures to detect and prevent the introduction of harmful organisms.

Awareness

A communication strategy should be an integral part of any invasive species management plan. A framework for strategic communication and awareness-raising should be developed and available to use during any pest outbreak. The framework needs to include: training for women and men farmers and extension workers, taking their different needs into account; training for journalists on emergency reporting; information on pest identification, symptoms, effects and chemical and biorational control methods. A variety of communication methods need to be used, including opinion leaders, farm days, field days, community demonstrations, local community centres, local radio, posters, schools, churches and NGOs, as part of a package of timely information dissemination after a new high-risk pest is identified. There need to be sufficient resources (funding), and the information technology infrastructure has to be sufficiently developed, to enable effective public education and stakeholder sensitisation.

Policy

A good invasives management plan, including funding mechanisms, is essential. The 2020-2030 NISSAP needs to be printed and distributed, including management (prevention and contingency) plans for new pest outbreaks, and emergency preparedness plans for high risk areas. Adequate resourcing of the plan is essential, including for surveillance activities. A contingency or emergency fund would enable a quick response to new pest outbreaks, especially as during the FAW outbreak, some institutions could not respond rapidly due to a lack of funding. The national taskforce should be maintained and extended to cover more invasive species, building on the experience gained through the FAW outbreak.

Collaboration

Collaboration and communication between stakeholders should be increased to harmonise and coordinate institutions' invasive species activities and remove barriers to implementation. Collaboration must extend to neighbouring countries, ensuring pest and disease information is shared. The taskforce should enable a coherent holistic response to deal with general invasive species issues, ensuring the presence and participation of technical experts, policy officers, local government, the media, gender and farmer representatives. Ideally, a farmer-centred bottom-up approach would be taken, that enables farmers to contribute their practical experience to any management plan, and ensures their buy-in to the management response.

Conclusions

The initial slow FAW response was attributed to a lack of resources, such as an emergency or contingency fund that could be accessed quickly to enable response measures to be put in place. However, as evidence of the economic impact of FAW became apparent, and financing was released, the response was considered very effective.

At a central level, stakeholders considered that the collaboration fostered through the taskforce played a critical role. All stakeholders were involved and it enabled them to work together, focusing on their individual strengths. There was greater sharing of knowledge, targeted allocation of resources, less working in isolation, and the involvement of the media within the taskforce was considered to provide faster and more accurate dissemination of knowledge to farmers. The success of the taskforce at the central level, led to a conclusion among the stakeholders, that this should be replicated at the local level, to ensure that the response to pest outbreaks was better coordinated at that level as well. This should enable a more farmer-centred approach, bringing in their practical experience of pests and ensuring strong buy-in of the country-wide response.

At the local level, the collaborative approach taken was also considered effective. Again, after the initial slow response, farmers and extension agents were satisfied with the information shared, and the pesticides that were distributed. Little mention was made of non-chemical control measures, though some extension officers recognised that they were needed in the future and would provide longer term solutions, especially if resistant varieties could be found. Information sharing, through a structured communication plan, was considered essential. In particular, the direct, face-to-face communication methods were highly appreciated by farmers and local government officials as face to face approaches provided a more tangible way of learning about new technologies. This should be taken into account in future communication plans, that should integrate face to face approaches with those of mass media, that can effectively reach many farmers with accurate extension messages quickly and easily, especially during an emergency response situation.

Going forward, there was consensus from all stakeholders that the country needs to be ready for future outbreaks of invasive species. Key steps to ensure this future preparedness include:

- implementation of the NISSAP (2020-2030);
- establishment of a standing taskforce to address new pest outbreaks;
- establishment of an emergency fund that will enable quick responses;
- improved monitoring and surveillance especially at borders and ports of entry;
- strengthened research capacity especially in pest risk analyses;
- development of a strategic communication plan to be used in the case of a pest outbreak, with clear information for decision making, especially by farmers;
- involvement of all stakeholders at central and local levels.

These measures should be put in place so that future responses are not dependent on whether the pest affects a food security crop such as maize, or another seemingly less important species, such as pasture species, aquatic species, or those that are key to maintaining the natural environment of Ghana.

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