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Recommendations for early prevention of crop pest and disease outbreaks

A CASE STUDY FROM THE AMASHIGA PROGRAM IN BURUNDI

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INTRODUCTION

In 2014, Catholic Relief Services (CRS) Burundi launched the five-year Amashiga Development Food Assistance Program (DFAP) awarded by Food for Peace (FFP)/United States Agency for International Development (USAID). Implemented across 230 collines[1] in all 7 communes of Burundi's Muyinga Province, the program is designed to yield sustainable and nationally replicable improvements in children's nutrition. Amashiga is focused on three integrated sectoral purposes (nutrition, agriculture, and governance) as well as cross-cutting gender programming aimed at promoting equitable decision-making within households.

Purpose 2 programming is focused on improving agricultural production in the Muyinga Province, contributing to the program goal of reduced malnutrition both through improved local access to nutritious food as well as increased income among vulnerable households to purchase these foods. In addition to training lead farmers to teach and monitor adoption of good agricultural practices at the local level, Purpose 2 activities also include strengthened seed systems, development of agricultural cooperatives, establishment of savings and internal lending community (SILC) groups to promote access to credit, integration with governance programming to promote improved disaster risk reduction (DRR) with local, communal and provincial early warning systems (EWS), as well as supporting individual households to practice home gardening. The Amashiga team works in close collaboration with the Muyinga Provincial Office for the Environment, Agriculture and Livestock (BPEAE) at the provincial, communal, and local levels to support program participants ranging from lead farmers, to producer organizations, as well as seed multipliers.

The majority of Muyinga households depend on agriculture for their livelihood. Despite three growing seasons each year, farmers struggle to produce adequate food for their families or to have a surplus to sell. Several factors contribute to this (including depleted soil, shortage of and limited access to inputs, and limited market linkages) but a key threat to Muyinga farmers are crop pests and diseases. The Amashiga program has focused its efforts on supporting farmers to mitigate the effects of two crop pest and disease threats relevant in the Muyinga Province - Fall Army Worm (FAW) and Banana Xanthomonas Wilt (BXW). To protect farmers from this crop pest and banana disease, Amashiga has encouraged adoption of a range of improved agricultural techniques while also supporting EWS to promote early detection of and response to these agricultural risks which threaten food security and nutrition in the province.

As both the on-going BXW disease and relatively new FAW infestation have posed significant threats to the food security of vulnerable communities in the Muyinga Province during the Amashiga program lifetime, the consortium team has continued adapting and honing its approach to inform best practices related to pest and disease control. This case study summarizes these refined strategies, documenting best practices for future programming in Burundi and offering lessons learned for adaptation in other contexts plagued by similar agricultural risks. Significant thanks is due to Amashiga consortium partners Bioversity International for their invaluable research conducted on BXW and SDSR in Muyinga and RBU 2000+ for their tireless commitment to accompany local farmers in adopting the developed strategies.

[1] *Colline* means hill in French and can be considered a proxy for "local community."

"This publication was possible thanks to the generous support of the people of the United States of America, through the United States Agency for International Development (USAID). The contents are the responsibility of CRS and do not necessarily reflect the views of USAID or the United States Government."

Banana Xanthomonas Wilt (BXW):

THE SINGLE DISEASED STEM REMOVAL (SDSR) APPROACH

CONTEXT

Banana is the major staple for the majority of households in Burundi with an estimated consumption of 300 kg per person per year, amongst the highest in the world. The Muyinga Province alone cultivates an estimated 139,000 tons per year, the most of any crop. As a result, banana is a key source of household food security and comprises a significant proportion of smallholder farmers' income.

BXW is pervasive in all banana growing regions of Burundi. The bacterial disease infects all banana varieties. Unlike most other diseases which mainly reduce yield, BXW destroys whole banana plants and can lead to complete yield loss, resulting in severe economic and food security loss for farmers and their families. Once BXW pathogens are established in smallholder plantations, control is very difficult; the disease is easily spread by insects and birds as well as via farm tools. Bacteria slowly infect the banana plant, causing the plant to defoliate, flowers to improperly pollinate, and fruits to prematurely ripen. The disease was first confirmed in Burundi in 2011 in two of the northwestern provinces; within the year, BXW had spread to 10 of Burundi's 17 provinces. Due to outbreaks in surrounding provinces as well across the border in Tanzania, the disease spread to four communes in the Muyinga Province during Amashiga implementation.

In 2011, ISABU (*L'Institut des Sciences Agronomique du Burundi)* conducted a study which warned of the serious livelihood consequences anticipated as a result of BXW. 91% of farmers expected a reduction in the number of daily meals while 80% feared inability to pay school fees as a result of diminished yields. The same survey found that levels of community awareness of BXW symptoms and control was very low. Only 8% of the surveyed population was aware of how BXW could be managed with only 5% practicing effective mitigation and control. The official control strategy at the time - complete mat removal (CMU) - mandated the removal and burial of the entire banana root system once one or more plants presented BXW symptoms. Where levels were higher, farmers were advised to uproot and destroy their entire plantation – a labor-intensive approach which results in the certain loss of all or part of farmers' banana harvest for a period of two years or more. Consequently, many farmers were reluctant to implement this technique, enabling the disease to easily spread.

STRATEGY

After demonstrated reluctance to implement the CMU control method by Burundian farmers, the single-diseased stem removal (SDSR) approach was developed in 2014 by Bioversity International as a simple alternative. This technique involves removing only the most infected stem from the banana plant and properly disposing of it. Removal of a single stem requires significantly less labor and allows for continued yields rather than a multiple year gap in productivity as farmers replant their plantations.

In 2016, Bioversity International, CRS and RBU 2000+ integrated the SDSR approach into Amashiga programming with the objective of confirming its technical viability, and as relevant, bringing the approach to scale in the Muyinga Province to inform the development of national policy in response to this country-wide threat. The pilot initiative first targeted 92 lead farmers in four different program zones who were trained to properly practice and teach the SDSR approach on their community demonstration plots. While program agronomists conducted regular monitoring, participating farmers formed into four learning groups convened for biweekly meetings to gather field observations and reactions to the new approach.

After a pilot period of 13 months, the BXW incidence rate was reduced from 8.8% to 0.3%, equating to a total of $372-$560 of banana revenue saved per household. After concluding that SDSR was an appropriate control mechanism for BXW in Muyinga, the Amashiga program team presented initial results to the DPAE and provincial authorities during a joint field visit and workshop. The SDSR approach was validated by provincial authorities, and agronomists across Muyinga are now encouraged to promote this successful and locally-supported strategy to control BXW.

To bring the SDSR approach to-scale across Muyinga, CRS and Bioversity International organized training-of-trainers' workshops with all 230 Amashiga lead farmers and 230 DPAE extension agents in June 2018. Together, these lead farmers and extension agents pairs collectively trained 17,942 farmers across Muyinga, each of whom received a laminated image-based factsheet to support correct BXW symptom identification and control.

An example of unevenly ripened bananas as a result of BXW in the Muyinga Province. Photo: CRS, 2017.

AMASHIGA KEY MESSAGES IN THE FIGHT AGAINST BXW

- BXW is a disease which affects all varieties of banana.
- BXW spreads easily through tools, insects, birds and animals.
- This disease can cause a total loss of crop.

SYMPTOMS:

- Wilting of leaves
- Early and/or uneven ripening of bananas
- Wilting of the male bud
- Brown stripes within the pulp of the banana
- Yellow oozing when cutting the pseudostem

IF PLANTS ARE INFECTED:

- Only cut the plants showing the above symptoms. Cut at the soil level and be careful not to contaminate nearby plants with the machete.
- After cutting, always create a hole in the middle of the pseudostem using the machete in order to kill the meristems.
- Avoid affecting other nearby crops (beans) by removing the infected banana trees in portions.
- After infected pseudostems have been completely dried, they can be added to household compost pits.

HOW TO STOP THE SPREAD:

- After cutting infected plants, disinfect the machete using fire.
- Do no remove asymptomatic portions of the tree.
- Do not permit goats or other livestock to walk within banana plantations.

HOW TO PREVENT BXW:

- Inspect your field weekly for BXW symptoms and remove all portions of the trees exhibiting symptoms.

IMPACT AND LEARNING

In August 2018 (two years after SDSR was first implemented in Muyinga), Amashiga conducted a series of 10 focus group discussions with farmers and marshland producer organization members as well as 3 DPAE representatives to evaluate local perceptions of this new approach to defeating BXW. Findings revealed both improved knowledge and correct practice of the SDSR approach as well as appreciation and buy-in. Farmers noted overwhelming preference for the SDSR approach over CMU due to the ability to resolve isolated cases of BXW without completely destroying their banana trees. A female farmer from the Butaramuka community in Gashoho Commune underscored this, stating, "we have learned not to cut all the bananas trees but only those attacked by the BXW and that leaves us with production which, even if smaller compared to what we would have harvested without the BXW attack, is better compared to nothing which is what occured before [when we used the CMU approach]." For this approach to be successful, farmers correctly noted the importance of frequent monitoring (on a weekly basis) of their banana trees for early BXW identification and control to prevent continuous spread.

While the majority of respondents affirmed the SDSR approach and demonstrated successful adoption, some reported hesitancy that removing infected banana trees would disrupt their bean plants (often intercropped with banana trees in Muyinga). When properly taught, the SDSR approach overcomes these concerns by teaching farmers to remove banana trees in small portions in order to not disturb nearby bean plants. While bean harvests constitute a significant portion of farmer revenue, this fear nonetheless has proven to be an obstacle in farmer adoption of the BXW method; thus, Amashiga has adapted messaging to invite farmers not to sow bean plants immediately beside banana trees so that potential removal will not disturb other crops. Addressing these concerns during the introduction of this approach is thus key to ensure early and full buy-in.

Many beneficiaries rightly celebrated that neighbors had observed the positive impact of the SDSR approach and adopted it on their own farms, contributing to community-wide protection. As BXW can be easily spread by animals and insects, encouraging mass uptake of the SDSR approach is essential so that participants adopting the practice experience positive results which reinforce their commitment to weekly monitoring. In addition to community sensitization, Amashiga promotes widespread adoption of the SDSR approach through integrated governance programming. Lead farmers are supported to participate in the local early warning system to underscore the threats posed by uncontrolled BXW and invite local leaders to join in mobilizing communities against it.

> *"We have known BXW since 2012, but before Amashiga we thought it was because of witchcraft. Now we understand it is a disease and we know how to protect our banana trees."*
>
> - Farmer from the Mirango Colline

While Amashiga's early pilot of the SDSR alternative validated both the technical approach as well as local communities' willingness for adoption, the key to containing this easily spread crop disease required quickly bringing it to scale. The program team's close collaboration with the DPAE was critical to train a wide cohort of 230 agronomists as well as ensure sustainability of this approach through government appropriation. In January 2019, a national policy workshop was convened by the Ministry of Agriculture to validate the SDSR approach. The Ministry is currently leading research efforts in additional provinces to confirm the technical efficacy of SDSR as a nationwide strategy.

Fall Army Worm (FAW):
THE INTEGRATED PEST MANAGEMENT APPROACH

CONTEXT

Spodoptera frugiperda, commonly referred to as fall army worm (FAW), is a crop pest that attacks more than 80 plant species, posing a significant threat to important cereals including maize, rice and sorghum as well as vegetables. In its adult stage, the insect can reach more than 100km per night, laying eggs upon plants which hatch as larvae and attack the plants. USAID notes that "due to its rapid spread and distinctive ability to inflict widespread damage across multiple crops, FAW poses a serious threat to the food and nutrition security and livelihoods of hundreds of millions of farming households in sub-Saharan Africa - particularly when layered upon other drivers of food insecurity."[2] If uncontrolled, Centre for Agriculture and Bioscience International estimates that FAW could lead to a collective reduction of 21-53% in yield amongst 12 maize-producing countries in Africa, resulting in a loss between US$2.5 – 6.2 billion.[3]

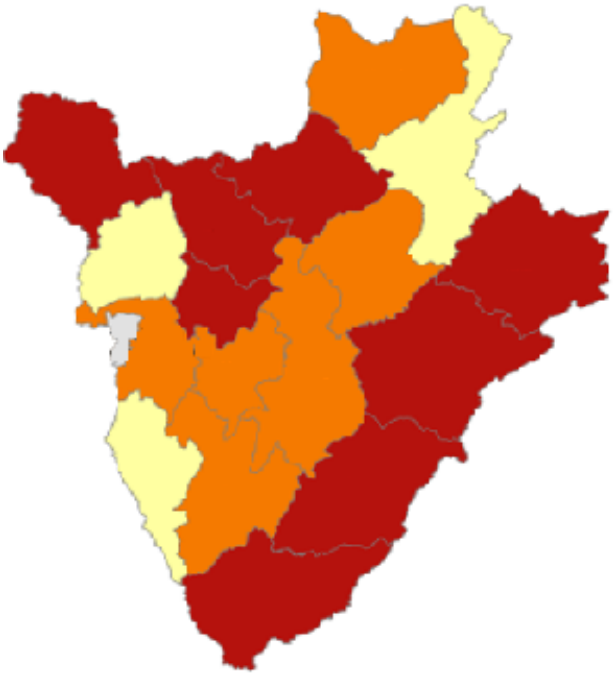
FAW was first reported in Africa in early 2016 and for the first time in Burundi in February 2016. As illustrated in the map below, FAW quickly spread across Burundi, with infestations reported in nearly every province by the 2018 agricultural season A (October – February) and estimated 95% of all agricultural households affected.[4] After sighting this pest in the Icizanya marshland in Muyinga during the 2017 agricultural season C (July-December), Amashiga agronomists organized a joint visit with local agricultural technical staff from the DPAE and confirmed its presence in all 13 marshlands. Agriculture actors in Muyinga had never before faced this threat nor knew techniques to combat it. In collaboration with DPAE, the Amashiga team quickly designed a response plan and adapted its agriculture

PRESENCE OF FAW IN AFRICA
AS OF FEBRUARY 2018[5]

Detected and officially reported

Detected, official reporting not completed at the time

IMPACT OF FAW IN BURUNDI
AS OF DECEMBER 2017[6]



> 30% damage

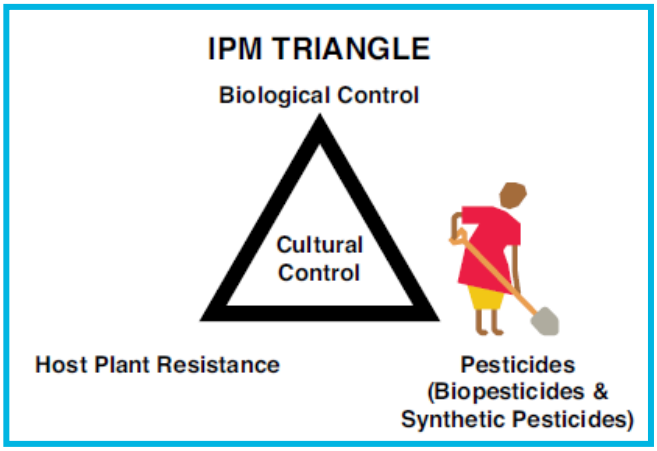
21% - 30% damage

1% - 20% damage

[2] USAID/Feed the Future. *Fall Armyworm in Africa: A Guide for Integrated Pest Management. First Edition.* 2018.
[3] Ibid.
[4] Groupe de travail technique IPC. *Cadre intégré de classification de la sécurité alimentaire : Burundi. Rapport #22.* 27 Avril 2018.
[5] FAO. 2018.
[6] FAO. 2017.

STRATEGY

USAID defines the goal of integrated pest management (IPM) as "to economically suppress pest populations using techniques that minimize harm to the environment, including people."[7] A holistic strategy, IPM is not a one-size-fits all approach; instead, it is contextually developed based on local farming conditions. As pictured to the right[8], IPM employs a suite of integrated approaches in order to prevent, identify, as well as respond to and suppress pest infestations. In response to FAW in the Muyinga Province, the IPM strategy developed by the Amashiga team consists of the following key strategies:



IPM STRATEGY TO DEFEAT FAW:

PREVENTION OF FAW

- **ADOPTION OF GOOD AGRICULTURAL PRACTICES:**
  - Good field maintenance (weed removal) and proper crop spacing enable farmers' efficient monitoring of caterpillars.
  - Use of quality seed, balanced fertilization and intercropping contribute to plant vigor which enables greater resilience to FAW effects.
  - Deep plowing brings FAW chrysalis to the surface for quick identification and removal.

IDENTIFICATION OF FAW

- **MONITORING, SURVEILLANCE AND SCOUTING:**
  - Organization of farmers or producer organizations to develop a consistent monitoring program at least twice weekly.
  - Effective communication system between farmers and local agronomists to rapidly identify and respond to FAW infestations.

SUPPRESSION OF FAW

- **MECHANICAL PEST CONTROL:** Organization of farmers twice weekly to collect and burn FAW caterpillars.
- **CHEMICAL PEST CONTROL**: Trained farmers are prepared to properly employ pesticides amongst young plants; this method is presented as a last resort to safeguard human, animals and soil as well as to manage potential insect resistance to pesticides. Successful chemical control is characterized by proper timing and placement to ensure the minimum amount is used to optimize impact.

[7] Groupe de travail technique IPC. *Cadre intégré de classification de la sécurité alimentaire : Burundi. Rapport #22.* 27 Avril 2018.
[8] USAID/Feed the Future. *Fall Armyworm in Africa: A Guide for Integrated Pest Management. First Edition.* 2018.
[9] Photos by ISABU.

To fully implement the IPM strategy, the following programmatic actions were led by the Amashiga team:

I. PREPARATION OF SENSITIZATION MATERIALS

The Amashiga team joined forces with the Food and Agriculture Organization of the United Nations to produce simple sensitization materials that could be used to increase farmers' awareness of FAW and associated risks nationwide. In June 2018, this poster was produced in the local language (Kirundi) and used in subsequent trainings.

II. GOVERNMENT COLLABORATION

To increase awareness of FAW and its potential impact on food security and nutrition, the Amashiga team quickly engaged local authorities at each level in the Muyinga Province to forge a network of leaders supporting local communities to quickly respond to FAW. Two initial trainings were held with members of the governor's cabinet, technical staff from the DPAE, leaders from each of Muyinga's seven communes as well as the Amashiga team. Amongst these participants, focus was placed on EWS committee representatives at the provincial and communal levels and their capacity to leverage the existing province-wide EWS to communicate agriculture-specific risk reduction measures.

III. CASCADE TRAININGS

In collaboration with the DPAE, Amashiga then rolled-out a series of trainings beginning with 230 agricultural extension agents and the 230 Amashiga-supported lead farmers. After learning the IPM strategy, this cohort of trainees were coached on how to integrate replication trainings into their existing activities. Amongst the 1,150 local leaders directly trained in FAW prevention, identification, and response throughout Muyinga included individual farmers, representatives of agricultural cooperatives present in the province's 12 marshlands and members of local EWS committees (to instigate both their communication of risks amongst vulnerable communities and reporting of cases up the EWS hierarchy).

In June 2017, a *Pesticide Evaluation Report and Safe Use Action Plan (PERSUAP)* was developed which outlined the active ingredients for potential use by Amashiga which align with Government of Burundi regulations. The Amashiga team secured orthene on the local market (with active ingredient acephate). While chemical control was presented as a critical aspect of the IPM strategy during all trainings, equipment (masks, gloves, boots, protective goggles and plastic suits)was provided only to lead farmers and cooperative leaders. These individuals attended a chemical control training which included the following themes:

- Pesticide use risks and mitigation
- Proper application and resistance prevention
- Pesticide transport and storage
- Pesticide/equipment maintenance and disposal
- Pesticide usage monitoring

To ensure use of pesticides is employed only as a last resort, farmers must contact one of these leaders who monitor proper use of the equipment in contexts which warrant them. As of September 2019, these leaders have been called on to treat 259 of the 286 hectares of maize fields targeted by Amashiga.

IV. SUPPORTIVE SUPERVISION FOR LOCALLY-LED SENSITIZATION

Through the leadership of 230 lead farmers (one per each colline in Muyinga) and 12 producer organizations (which collectively cultivate 242 ha or 40% of Muyinga's 12 marshlands), Amashiga established 242 demonstration plots to model proper FAW management. Through this network, every farmer in the Muyinga Province has access to a demonstration plot with an average proximity of 1 km.

Amashiga staff together with DPAE agents accompanied lead farmers during demonstrations at each of these 242 plots which effectively serve as IPM training centers. Demonstration plot sessions model correct implementation of good agricultural practices, scouting, mechanical control and chemical control while nuancing which techniques are most appropriate at different stages of FAW infestation. Lead farmers also engage their communities in dialogue about how to share data through the province-wide EWS. Two years after demonstration plots were first established, lead farmers continue to receive supportive supervision, continuously honing their ownership of key IPM messages and facilitation techniques while increasingly conducting home visits to provide tailored support to particularly vulnerable households.

In February 2019, Amashiga launched a series of farmer field days conducted in all 26 zones each quarter. While these events cover the same content promoted at demonstration plots (focused on IPM), they help reach a wider audience, inviting Amashiga beneficiaries from across the program's multi-sectoral interventions and promoting mass sensitization on FAW.

V. ON-GOING MONITORING

In addition to monitoring the proper use of IPM techniques on individual farmers' plots, field visits equally focused on community members' knowledge of and engagement with the EWS system. Continuous support was provided to colline-level EWS committees - the first of their kind in Burundi – to actively contribute to FAW surveillance and reporting to colline chiefs who now discuss FAW updates during weekly security meetings at the communal level.

Additionally, Amashiga contracted ISABU to conduct a study monitoring the incidence of FAW in Muyinga marshlands between September 2018 and February 2019, enabling the program team to analyze the impact of the Amashiga IPM strategy to defeat FAW.

IMPACT AND LEARNING

ISABU's study focused on two of the Muyinga Province's marshlands and revealed that the IPM approach promoted by Amashiga significantly protected Muyinga farmers' maize harvests during the 2018 agricultural season C (July-December). According to ISABU's analysis, each marshland was 100% susceptible to FAW infestation prior to implementation of the IPM approach. By the end of the maize harvest in February 2019, ISABU recorded infestations rates of only 1.6% and 4.6% in Icizanye and Nyabihana, respectively. Additionally, since FAW caterpillars damage ears of maize (as opposed to the plant) only during heavy infestations, ISABU measured damage to maize kernels in particular and discovered only 0.7% of ears in Icizanya and 1.5% in Nyabihana were damaged, revealing that FAW infestations have been effectively controlled.

In addition to positive results for farmers in Muyinga, Amashiga's piloted IPM strategy has also impacted FAW readiness nationwide. After this response was rapidly launched throughout the entire province in 2017, the Minister of Agriculture visited Muyinga marshlands after agricultural season A (October - February) and noted the successful protection relative to other provinces. As a result, MINAGRIE invited Amashiga leadership to participate in a taskforce to develop a nationwide FAW action plan which was validated and launched in May 2018. The plan consists of four priority areas – i) coordination and collaboration, ii) communication, awareness raising, capacity building and research, iii) evaluation and impact study, and iv) integrated and sustainable management/control based on screening, surveillance, and early warning. In collaboration with other key FAW actors (including MINAGRIE, FAO, and ISABU), Amashiga has strengthened both commitment and capacity at the national level to effectively control FAW in the future.

Amashiga's success in quickly controlling FAW in Muyinga was largely based on the program's ability to integrate messaging into an EWS by leveraging existing local structures. Collaborating with local authorities serving in EWS committees at the local, communal, and provincial level implicated leaders not traditionally engaged in technical agriculture work but who play a critical role in quickly mobilizing communities. Amashiga's integrated programming design (including agriculture and governance) served to quickly activate colline-level EWS committees, a locally-led, sustainable structure with the capacity to respond to FAW and a wider spectrum of risks affecting food security.

Amashiga participants celebrate a rise in maize production following application of the IPM strategy. Photo: CRS, 2018.

While piloting this strategy, Amashiga staff explored potential adaptations for continuous improvement and refinement in the future. Observations during field visits were confirmed during a series of focus group discussions with Amashiga farmers in December 2018 in which participants noted their practice to integrate traditional pest control methods into the larger Amashiga IPM strategy. These methods include the use of ash, neem or palm oil, as well as chili. In comparison to chemical pest control, farmers noted preference for these methods because they rely on locally available products which are relatively cheap and they also pose no environmental threat. Use of neem tree oil as a botanical pesticide has proven successful in numerous other contexts afflicted with FAW[10] and is already produced across plant nurseries in the Muyinga Province. In addition to its pest control properties, neem trees are drought resistant and contribute to soil fertility; thus, they are an agro-forestry asset often planted in fields where coffee, cotton, tea and food crops are intercropped. Based on this community-driven learning produced during the program, the Amashiga team has shared these strategies with the national FAW taskforce for their further study and validation.

After implementation of the Amashiga IPM approach, DPAE Inspector Jean-Claude Mbarushimana celebrated the end of the 2018 agricultural season C (July-December) stating:

"FAW did little damage as evidenced by production estimates ranging from three to four tons per hectare."

[10] USAID/Feed the Future. *Fall Armyworm in Africa: A Guide for Integrated Pest Management. First Edition.* 2018.

Recommendations:

KEY TAKE-AWAYS FROM AMASHIGA PROGRAMMING TO INFORM FUTURE PROGRAMS MANAGING CROP PESTS & DISEASES

- While crop pest and disease control depends on the technical inputs of agricultural authorities and local research institutions, the success of community-driven strategies equally depends on the engagement of elected officials. Authorities reiterating the risks associated with BXW and FAW at each level of government in Muyinga was critical to achieve mass sensitization.

- To elevate widespread understanding of pests and diseases, CRS worked through the existing DRR platform organized through the national government. Through the development of operational early warning committees at the colline and commune level to feed field-level information to the provincial and national levels, heightened focus was placed on the threats posed by agricultural disasters. Integration of crop pest and disease updates into weekly security meetings throughout the province ensures that agricultural DRR is sustained.

- While both Amashiga approaches were initiated as pilots at the local level, they were rolled -out with both sustainability and scale in mind. Today, a network of 230 lead farmers and 230 DPAE extension agents are equipped to reinforce crop pest and disease management across the Muyinga Province following the Amashiga Program. At the national level, early engagement with government officials enabled continuous learning from Muyinga to inform the on-going development of country-wide strategies and policies. Securing a role in national action plan committees ensures that successes outlive the program lifetime and continue to serve vulnerable communities.

- The Amashiga pest and disease control strategies were consistently centered on a cohort comprised equally of program-targeted lead farmers and local agricultural extension agents. Through regular reinforcement of these pairs' joint efforts, the program helped raise the profile of lead farmers and effectively linked them to technical officials capable of providing sustained support.

- Once Amashiga crop pest and disease control strategies were rolled out, the program organized exchange visits between different associations and authorities so that the responsibility of continued learning was shifted to successful leaders in the field.

- When training local authorities and lead farmers in new techniques, providing certificates is beneficial for participants to take pride in the new knowledge set that they are now equipped to practice and promote in service of the wider community.

- The formation of regular farmer learning groups enables a program to monitor both adoption of and local perception of new techniques. This time-intensive mechanism is highly recommended during the pilot period to promote rapid testing and adaptation; however, it is unsustainable at-scale. Once tested approaches are extended to a wider community, monitoring techniques should be simplified and rely on local leadership.

- While Amashiga rolled the SDSR strategy out in local communities, the program team simultaneously explored the introduction of BXW-free banana tree species imported to Burundi. This strategy proved unsuccessful as community members were not easily convinced to invest in improved species while cheaper, local species remained easily accessible. This exploration underscored the sustainable impact of behavior change (supporting farmers to conduct BXW monitoring weekly) as opposed to attempting to eradicate the crop disease through the one-time costly introduction of new species.

- While the IPM strategy integrates different approaches in response to FAW, heightened focus on mechanical control is key. Both free to implement and devoid of environmental impact, this method is the most accessible for communities to sustain once programs have closed. When first introduced, however, the success of this approach requires repeated

mass sensitization. Successfully empowering local agronomists and authorities to play a significant role in this campaign is critical to developing sustainable mass buy-in to a new practice.

- Before introducing IPM strategies, teams must develop a strong understanding of local pest control solutions and work to integrate them into their larger framework so that communities are supported not to change their practice but instead enrich it. Ideally, the impact of already practiced techniques should be tested and evaluated. Incorporating methods preferred by communities due to accessibility is key to sustainability.

- As early as possible, programs should collaborate with local research institutions to investigate resistant plant varieties. Critical for successful IPM strategy, promotion of cultural control is resource-intensive and thus must be incorporated early into IPM strategy roll-out.

- Programs must ensure that sensitization on use of improved quality seed (to enhance host plant resistance) is coupled with improved access to seed, warranting an intentional market linkages strategy. For example, the Amashiga team leveraged a network of private service providers leading savings and internal lending community (SILC) activities to sell improved seed at SILC group meetings and activities organized by lead farmers such as farmer field days.

- Lastly, combatting crop pests and diseases was a critical component of the Amashiga Program's goal to reduce childhood malnutrition, both by protecting food crops and farmers' income. In-line with the promotion of dietary diversity, agricultural programming should simultaneously promote pest/disease control strategies and crop diversification in order to immediately reduce the impact of these threats on food production.

Amashiga participants celebrate a rise in maize production following application of the IPM strategy. Photo: CRS, 2017.

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