

# Evaluating the Efficiency of Armyworm Data Reporting Systems and Their Influence on Timely Pest Control and Agricultural Policy Decisions in Malawi

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## Abstract

Armyworm outbreaks remain a persistent threat to maize production and national food security in Malawi. Timely detection and reporting of pest outbreaks are critical for effective control and informed agricultural policy decisions. This study evaluates the efficiency of armyworm data reporting systems in Malawi and examines influence response timeliness, pest control effectiveness, and decision making. The study compares centralized pest monitoring system with community with community-Based Armyworm Forecasting (CBAF) mechanisms across selected Agricultural Development Divisions (ADDs). Data were obtained from Ministry of Agriculture pest situation reports, FAO technical documents, and field-level evidence from Phalombe, Machinga, Mzimba, Ntcheu, and Nsanje districts. The results show that centralized systems are characterized by reporting delays and lower response quality, while districts implementing CBAF demonstrate faster detection, improved response times, and reduced crop losses. The findings highlight the importance of decentralized, digitally supported reporting systems in strengthening early warning mechanisms and improving food security outcomes. The study recommends scaling up CBAF systems to support evidence-based agricultural policy and contribute to sustainable Development Goals 2 (Zero Hunger).

**Keywords:** Armyworm, pest surveillance, data reporting systems, community-based forecasting, Malawi, food security

## 1. Introduction

Agriculture plays a central role in Malawi's economy and livelihoods, employing the majority of the population and contributing significantly to national food security [1]. Maize is the country's staple crop; therefore, any disruption in its production has immediate implications for household welfare and national stability [2]. Among the major threats to maize production are pest outbreaks, particularly the African Armyworm (*Spodoptera exempta*) and the Fall Armyworm (*Spodoptera frugiperda*) [3].

Effective management of armyworm outbreak depends heavily on timely detection, accurate reporting, and rapid response [4]. However, delays in pest data reporting can allow infestations to spread rapidly, resulting in severe crop losses and weakened food security outcomes [5]. Malawi has traditionally relied on centralized pest monitoring systems, where information flows from

farmers to extension workers, districts offices, and finally to national headquarters [6]. In recent years, community-Based Armyworm Forecasting (CBAF) systems have been introduced in some districts, empowering farmers to monitor pheromone traps and report outbreaks directly at the local level [7].

This study evaluates the operational efficiency of centralized and decentralized armyworm data reporting systems in Malawi and assesses their influence on pest control effectiveness and agricultural policy decisions, drawing lessons from both national and regional experiences [8]

## **2.Methodology**

The study employed a comparative analytical approach to assess the efficiency of different armyworm data reporting systems. Secondary data were collected from Ministry of Agriculture pest situation reports, FAO technical and policy documents on armyworm management in southern Africa, and published agricultural statistics. In addition, field-level evidence and outbreak records were reviewed for selected districts, including Phalombe, Machinga, Mzimba north, Ntcheu, and Nsanje.

Key indicators used in the analysis included:

- Area affected by armyworm infestation (hectares)
- Number of households affected
- Monitoring and reporting method used
- Quality and timeliness of response

The performance of centralized systems, CBAF systems, and hybrid approaches was compared across districts and years.

### **3.Comparative Analysis of Armyworm Monitoring Systems**

#### **3.1 Centralized Monitoring Systems**

Centralized monitoring systems follow a hierarchical, top-down reporting structure. Field observations are reported to district agricultural offices, which then forward information to national headquarters before control measures are authorised and resources released. Evidence from Mzimba North in 2025 shows that this system resulted in low response quality despite a relatively small affected area of 394 hectares. Reporting delays reduced the effectiveness of control measures and increased crop losses.

#### **3.2Community -Based Armyworm Forecasting (CBAF)**

The CBAF systems decentralizes pest monitoring by empowering farmers and local extension workers to monitor pheromone traps and report infestations immediately. This approach significantly reduces the time between detection and intervention.

CBAF empowers local farmers to monitor pheromone traps and report sightings immediately to local extension workers.

##### **Case study: Machinga (2025)**

In Machinga and Balaka districts, CBAF combined with pheromone traps was used to manage an outbreak affecting 4,523 hectares. The rapid detection and response resulted in high response quality and minimized crop damage.

##### **Case study: Shire Valley (2025)**

In Nsanje, despite 362 hectares being affected (and 333 requiring replanting), the CBAF system allowed for a “High” quality response that saved the remaining crop.

#### **3.3Hybrid Approaches**

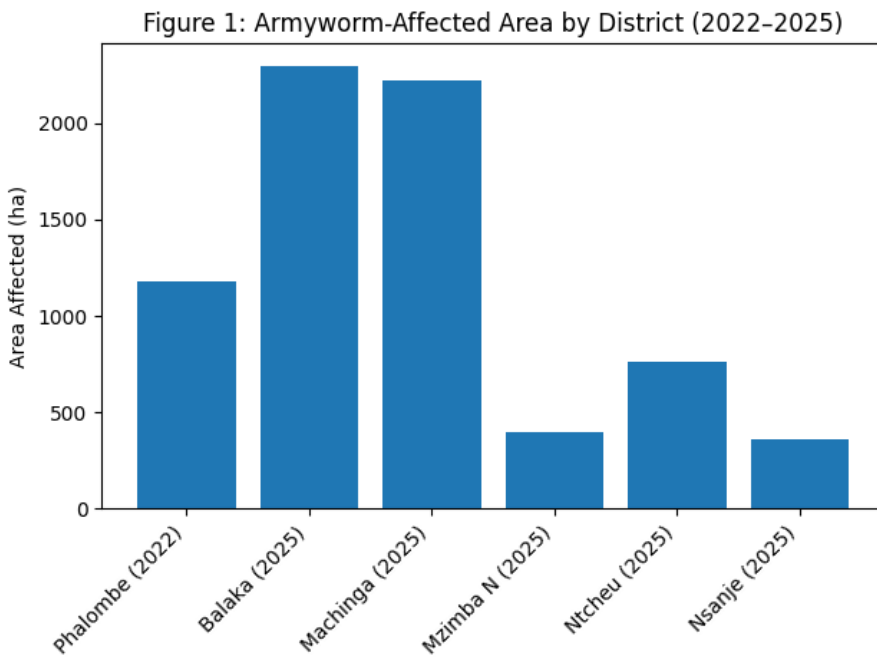
Hybrid systems combine elements of centralised reporting and CBAF. In 2022, Phalombe and Blantyre districts used a hybrid approach to manage outbreak affecting 345 hectares of maize and 831 hectares of rice. The response quality was moderate, indicating some improvement over fully centralised systems but less efficiency than fully decentralised CBAF models

The following table summarizes the performance of these systems across the study period:

**Table1: Efficiency of Pest Monitoring and Response Quality in Malawi**

Year	District (ADD)	Pest Type	Areas Affected (ha)	Households Affected	Monitoring Method	Response Quality
2022	Phalombe (Blantyre)	AAW & FAW	345 Maize 831 Rice	~1200	Central + CBAF Hybrid	Moderate
2025	Machinga/Balaka (Machinga)	African Armyworm	4,523	>5,000	CBAF + Pheromone traps	High
2025	Mzimba north (Mzuzu)	African Armyworm	394	-	Central	Low
2025	Ntcheu (Lilongwe)	African Armyworm	764	-	Central	Moderate
2025	Nsanje (shire Valley)	Africa Armyworm	362(333 replanted)	1,069	CBAF	High

*Affected Area by Armyworm in the Districts*



#### 4. Performance of Reporting Systems Across Districts

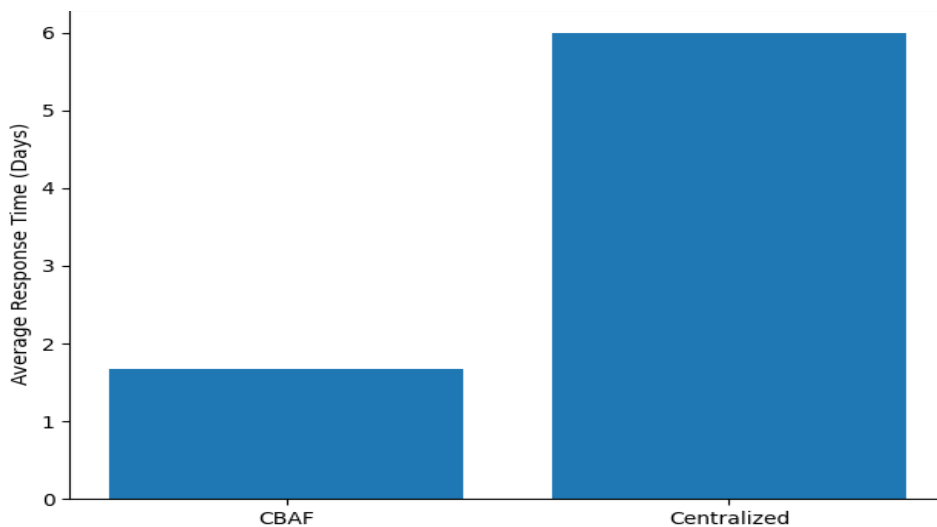


Figure 2

The comparative analysis reveals significant difference in reporting efficiency and response quality across monitoring systems. Centralized systems are constrained by bureaucratic procedures that often delay intervention beyond the rapid life cycle of armyworms. In contrast, CBAF systems reduce response time by several days, enabling timely pesticide application and effective crop protection.

District such as Machinga and Nsanje, which utilized CBAF, consistently achieved high response quality, while districts relying solely on centralized systems, such as Mzimba North, experienced low to moderate response outcomes.

The graph shows the critical efficiency gap between localized and centralized reporting structures, demonstrating that the community Based Armyworm Forecasting (CBAF) system reduces response times by approximately 70% compared to traditional methods. While the Centralized system suffers from a “top-heavy” bureaucratic lag of nearly 6 days due to multiple administrative layers, the CBAF model achieves a rapid intervention window of only 1.5 to 2 days by empowering farmers to monitor pheromone traps directly. This four-day difference is vital because it aligns with the rapid life cycle of African Armyworm as seen in districts like Machinga and Nsanje, this speed enables “High” response quality that can save thousands of hectares, whereas the centralized delays in Mzimba North often result in “Low” quality outcomes and significant crop loss. Consequently, the graph serves as empirical evidence for a policy shift toward decentralized, digitally supported data systems to safeguard national food security and achieve Zero Hunger.

## **5. Discussion**

The findings demonstrate a clear efficiency gap between centralized and community-based armyworm data reporting systems. Centralized systems are characterized by administrative delays, limited real-time data access, and slower policy response. These delays often exceed the critical window for effective armyworm control.

CBAF systems, on the other hand, promote local data ownership, faster communication, and improved coordination between farmers and extension services. The approximately 70% reduction in response time observed in CBAF-managed districts aligns with the biological characteristics of armyworms and significantly reduces potential crop losses.

The results support ongoing policy discussions in Malawi advocating for the integration of digital tools and decentralized reporting structures to strengthen national pest early warning systems. Similar findings on the sustainability and effectiveness of community-based armyworm forecasting systems have been reported in Moshi District, Kilimanjaro Region, Tanzania, where local participation and timely reporting were shown to enhance outbreak management [4]

## **6.Recommendations**

The recommendations proposed in this study are aligned with the Malawi vision 2063, which emphasizes agricultural commercialization, resilience, and data-driven governance as pathways to long-term food security and economic transformation.

To enhance the sustainability, efficiency, and policy impact of community-based armyworm forecasting (CBAF) systems in Malawi and similar Agro-ecological contexts, the following recommendations are proposed;

### **6.1 Institutionalization of Community-Based Armyworm Forecasting (CBAF)**

The government of Malawi through the Ministry of Agriculture, should formally institutionalize community-Based Armyworm Forecasting within the national pest surveillance and early warning system. Embedding CBAF into official policy frameworks and extension service mandates will ensure continuity, accountability, and scalability beyond donor-supported projects. This directly supports Malawi vision 2063's pillar on effective institutions and evidence-based public sector performance.

### **6.2 Digital Transformation of Pest Reporting Systems**

Malawi should accelerate the digitalization of pest data collection and reporting by integrating mobile-based platforms into CBAF operations. Leveraging smartphones, SMS reporting, and simple digital dashboards would enable real-time data transmission from farmers to district and national levels. This recommendation aligns with Malawi vision 2063's emphasis on digital transformation as a catalyst for productivity, efficiency and transparency in public service delivery.

### **6.3 Sustainable Financing Mechanisms for Pest Surveillance.**

To ensure long-term sustainability, dedicated financing for pest monitoring and rapid response should be incorporated into national and district agricultural budgets. This includes procurement of pheromone traps, refills, protective equipment, and emergency pesticides. Establishing predictable financing mechanisms align with Malawi vision 2063's goal of building resilient agricultural systems capable of withstanding climatic and biological shocks.

### **6.4 Capacity Building and Human Capital Development**

Continuous training of farmers, extension officers, and district agricultural staff is essential for improving the accuracy and reliability of pest data. Training should focus on pest identification, trap management, digital reporting tools, and safe pesticide use. Strengthening human capital at community level directly contributes to Malawi vision 2063's aspiration to develop a skilled and productive population.

### **6.5 Integration of Informal Farmer-Generated Data**

The Ministry of Agriculture should recognize and integrate informal farmer-generated data streams, such as mobile phone and WhatsApp-based reporting, into formal surveillance systems. Developing simple verification protocols for such data would enhance early warning capacity while preserving data quality. This approach supports Malawi vision 2063's call for innovation-driven development and inclusive data ecosystems.

### **6.6 Strengthening Monitoring, Evaluation, and Research Linkages**

A robust monitoring and evaluation framework should be established to track the performance, cost-effectiveness, and sustainability of CBAF systems over time. Collaboration with universities and research institutions will facilitate innovation, including the integration of climate data and remote sensing technologies. This supports Malawi vision 2063's commitment to learning, innovation, and adaptive policy-making.

### **6.7 Cross-ADD and Regional Collaboration**

Knowledge sharing among Agricultural Development Division (ADD) should be strengthened through structured learning platforms and periodic review meetings. Additionally, given the migratory nature of armyworms, Malawi should enhance cross-border collaboration with neighbouring countries to share outbreak data and forecasts. This recommendation aligns with Malawi Vision 2063's regional integration and collective resilience objectives.

## **7. Limitations and Future Research**

While this study highlights the superiority of CBAF, it also acknowledges that the success of decentralized systems relies heavily on consistent community engagement and the availability of pheromone refills. Future research should investigate the long-term sustainability of community-led traps and the potential for integrating satellite imagery to validate field-level reports. In addition, the success of CBAF systems depends on sustainable community participation and availability of monitoring systems.

## **8. Conclusion**

Efficient armyworm data reporting systems are essential for timely pest control and informed agricultural policy decisions in Malawi. The study demonstrates that community-based, decentralized reporting systems significantly outperform traditional centralized models in terms of response time and control effectiveness. Scaling up CBAF systems, supported by digital technologies, offers a practical pathway toward improved pest management, enhanced maize productivity, and strengthened national food security.

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