Fall Army Worm Network Tracker (FAWN-Tracker) System: *Emerging Pest Surveillance and monitoring*

We propose Fall Army Worm Network Tracker (FAWN-Tracker) System as an end-to-end integrated surveillance and threat assessment platform [not just a tool] that innovatively incorporates technology, stakeholder engagement, and science to guide targeted intervention for rapid and timely control of Fall Army Worm (FAW), and may become a prototype for other emerging pest-related threats to food security in sub-Saharan Africa. This project will lead to the design and deployment of an indigenous before- and real-time alert system that leverages on crowdsourced data, real-time hyperlocal weather data, and optimized algorithms derived from UAV-derived spatial datasets and biological models.

20 June 2017, after two emergency meetings in previous months, the United Nations Food and Agricultural Organization (UN-FAO) released a briefing note to highlight the emergence of a high-profile threat in African agroecosystems, the Fall Army Worm – FAW (*Spodoptera frugiperda*). Food security in sub-Saharan Africa is hinged on farmers' ability to address nutrient limitations, adopt proven management strategies, and swiftly mitigate any emerging threats (including pests and diseases). The first two needs can be anticipated and proactively addressed, however, the threat of pest and diseases are often triggered by unforeseen events such as weather and inadvertent human-related events. Due to difficulty in predicting potential causal events, the emergence of new pest threats in sub-Saharan African (SSA) agroecologies constitutes significant concerns for governments and major stakeholders within the major crop value-chain.

Fall Army Worm (FAW) emerged in 2016 as an unconventional pest in sub-Saharan Africa, and has been reported in 25 African Countries. Within 1 year, UN-FAO reported that it has ravaged 1.5 million ha of Maizeland in 6 African Countries, including Nigeria. No rapid or real-time system currently exists to track, assess, and mitigate the spread of FAW (or other economically important pests) in the continent, hence, we are proposing FAWN-Tracker System as an innovative tool to monitor outbreak, analyze/detect hotspots and infestation process, and translates such information for timely action both at farmers' and institutional level. Data collected will be looped-back into the System to evolve a robust alert framework for this vicious pest, in the target geographies. This will also become an unprecedented prototype for "before-time" and "real-time" advisory system that can be adapted to existing or new noxious pests in African agroecosystems.

Hypothesis 1: The deployment of FAWN-Tracker provides real-time and location-rich information to detect hotspots of FAW outbreak in target geographies and generates evidence for targeted intervention at scale to minimize losses to smallholder farmers.

Hypothesis 2: Fusion of hyperlocal real-time weather data, near-real-time crowdsourced incidence reports, and agronomic datasets collected through FAWN-Tracking System provides a reliable FAW early warning system and strengthens value-chain actors to deploy effective solutions that matches scale and context of FAW's outbreak in target geographies.

We have very high expectation of success because of 4 factors – i. ***Top-priority Need*** (generated interests from top institutions, such as FAO), ii. ***Our Team*** (highly-experienced and multi-disciplinary), iii. ***Ready-to-go Infrastructure*** (UAV Procured, Weather Stations Installed, Enumerators Enlisted, Crowdsourcing platform already in development); and iv. ***Our recent Successes on crowdsourcing data*** (e.g. in April 2017 – we

implemented a crowdsourced data collection to map over **~1400 agrodealers** in target geographies within **~3days**!; also we have successfully implemented UAV flight missions at 5 locations within target geographies)

We will implement this project by focusing on core elements, namely Distribution/Ecology, Biology, Control, and Alert *(*Pilot phase will likely focus on Distribution and Biology).* The Chart below shows a broader (but simple) conceptual framework for FAWN-Tracker System.

Fall Army Worm Network Tracker (FAWN-Tracker) System – Conceptual Framework

Element	Distribution	Biology	Control	Alert
Action/Targets	**Engage Stakeholders** - Scientists - Knowledge Experts - Extension Agents - Farmers	**Assess Drivers** - Weather - Soils - Planting Time - Infestation/Damage	**Determine Impact** - Severity and Extent - Economic impact - Mitigation Adoption	**Develop Tool(s)** - Data feedback loop - Multi-level Alerts - Recommendation - Multi-lingual
Methods/Tools	**Crowdsource Incidence reporting** - Smartphone-based - Open Data Kit - Shiny App/Interface	**Research/Sampling** - Determine Generation?? - Assess survival - Pest Density - Test control methods	**Quantify Damage** - UAV/Drones (+GPS) - Maximum Entropy Model - Survey	**Prototype and Refine** - GIS Analytics - Programming - Rich Data - Database on FAW

Data that will be generated include – ***i.*** Location-specific FAW incidence in near-real-time; ***ii.*** Hyperlocal real-time weather data (including Temperature, Precipitation, relative Humidity, wind speed, and wind direction); ***iii.*** top-soil data (including soil carbon, pH, nitrogen, and texture); ***iv.*** Spatially-explicit remotely-sensed data on vegetation indices, coverage, and elevation.

If the pilot is successful, we will **i.** scale-up and deploy the tool through UN-FAO for testing in major maize production belt of "*high-priority*" at- risk Countries (FAO is leading consultation on FAW already). **ii.** conduct more intensive spatio-temporal data collection based on preliminary insights from the data that are generated during initial pilot stage. **iii.** The FAWN-Tool will be adapted for other emerging pest threats (relevant to priority crop, such as Cassava) and a beta version for target pest(s) will be developed. The development, data collection, and testing will run parallel to FAWN -Tracker up-scaling and out-scaling.

i.	Procurement of data crowdsourcing devices	$10,000
ii.	Routine Maintenance of 30 ground weather station	$8,000
iii.	Collection of Data on soils and with UAV	$10,000
iv.	Training costs of 40 first responders in the use of FAWN Tracker	$15,000
v.	Triage cost for 40 "first-responders"/technical crowd (4months)	$20,000
vi.	Ideation and development of FAWN-Alert App	$15,000
vii.	Payment for support services and miscellaneous	$5,000
viii.	Institutional Overhead Charges	$14,940 **Total = $97,940**