ASSESSING THE LEVEL OF AWARENESS & CAPACITY OF FOREST MONITORING PERSONNEL ON THE USE OF TECH-BASED TOOLS FOR FOREST MONITORING IN GHANA

BASELINE REPORT

AUGUST 2024

Knowledge for World Conservation (KWC)

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Abbreviations

ADM	Assistant District Manager
ATEM-OFD	Application of technology to enhance monitoring of the forest in the Offinso Forest District of Ghana
CAPI	Computer-Aided Personal Interview
DM	District Manager
FC	Forestry Commission
FSD	Forest Services Division
GFW	Global Forest Watch
GIS	Geographic Information System
GPS	Global Positioning System
MTS	Modified Taungya System
OFD	Offinso Forest District
PADO	Private Afforestation Developer Organization
WiTG	Women in Timber Ghana Association
WRI	World Resources Institute

Highlights of Baseline Study

Digital Literacy and Tool Awareness

- A mix of basic and advanced digital skills was observed among respondents.
- Familiarity is highest with GPS/GIS (70%) and mobile forest monitoring apps like Avenza (22.2%).
- Lower awareness of advanced tools like drones (50%), satellite imagery (38.9%), and remote sensors (11.1%).

Current Forest Monitoring Practices

- Most monitoring is done manually, using field surveys and limited GPS functions.
- Regular monitoring activities include boundary and fire-belt (greenbelt) maintenance, bushfire detection, and protection against illegal activities (logging, mining).
- A lack of technology adoption leads to gaps in real-time monitoring and inefficient resource allocation.

Perceived Benefits of Smart Monitoring Tools

- 100% of respondents believe smart tools would enhance monitoring efficiency, providing real-time alerts, improving safety, and reducing time spent on field inspections.
- Key benefits anticipated include faster response to deforestation and illegal activities and better preparedness for potentially dangerous situations.

Training and Equipment Needs

- Essential needs include basic operation training (80%), advanced technical training (75%), regular workshops (85%), and reliable technical support (95%).
- 100% of respondents indicated a need for smart tools, such as smartphones or tablets, for field monitoring.

Willingness to Adopt Smart Monitoring Techniques

- High enthusiasm for adoption: 77.8% are “very willing” and 11.1% “willing” to integrate smart monitoring tools.
- Respondents recognize the potential for these tools to improve routine monitoring and enhance their protection roles.

Challenges and Barriers

- Key barriers include limited digital literacy, lack of hands-on experience with advanced tools, and insufficient resources for training and technical support.
- Current reliance on manual methods is labor-intensive and less responsive to dynamic forest threats.

Recommendations for Implementation

- A phased approach is recommended, starting with basic equipment supply, foundational training, and regular skill development workshops.
- Establishing partnerships with technology providers like Global Forest Watch, Government Agencies and other conservation organizations will be critical for sustainable and scaled – up implementation.

Background

Ghana is experiencing an annual deforestation and forest degradation rate to 2%, equivalent to 135,000 hectares loss of forest cover, primarily due to anthropogenic factors.[1] In spite of the efforts by the Ghanaian Government and private plantation developers implement reforestation and plantation initiatives, their impact remains inadequate to counteract the rate deforestation.

Significant threats to natural forests protection and massive plantation development investments in the form of wildfires, illegal felling of timber and chain sawing, cattle grazing and illegal mining popularly referred to as 'galamsey', unauthorised farming particularly in the Offinso Forest District (OFD), requires immediate attention. These illegal forest disturbances in the reserves are occurring due to ineffective monitoring and protection systems, weak enforcement capacity of forest monitors and deficient community inclusiveness in forest governance. Interventions are hindered by high turnaround time, which does little to prevent the rampant illegal forest disturbances in (near) real-time and heightens the vulnerability of households dependent on forest resources in the fringe communities.

Modern forest monitoring heavily relies on prompt and verifiable forest disturbance signals for rapid enforcement actions. However, Ghana's forest monitoring framework remains largely dependent on 'legwork' with little to no application of modern technologies which make monitoring much more ineffective and not safe. There is an observed gap in the interaction between forest managers, who are the primary forest law enforcers, the forest guards, who operate as the front-line controllers of Ghana's forest reserves, and the fringe communities, who are dependent on the forest resources. Deforestation in Ghana is increasingly becoming sophisticated and actors are taking advantage of the monitoring gaps to their benefit.

With funding from World Resources Institute (WRI) through the Global Forest Watch (GFW) Small Grants Programme, the Knowledge for World Conservation is implementing the ***"Application of technology to enhance monitoring of the forest in the Offinso Forest District (OFD) of Ghana"*** project, ATEM-OFD project for short. Adopting a triangulation approach, the project will combine modern forest monitoring technology tools with collaborative effort among forest supervisors, guards and the local communities to effectively monitor, report and control illegal forest activities in the OFD.

The baseline study was conducted in July 2024, to understand the current forest monitoring framework and practices in the Offinso Forest District, and assess the awareness, capacity of forest personnel in the Offinso Forest District on the use of tech-based forest monitoring tools to guide collaborative implementation strategies under the project.

[1] (Kyere-Boateng & Marek, 2021).

Aim of Baseline Study

Based on the scope of the ATEM-OFD project, the following are the specific goals of the baseline survey:

- To document existing methods, frameworks, and workflows used by forest supervisors, guards, and local communities to monitor forest health and report illegal activities in the Offinso Forest District.
- To determine the level of awareness and understanding among forest personnel regarding available forest monitoring technologies and their applications.
- To assess the technical capacity, skills, and confidence of forest personnel and community members in using tech-based forest monitoring tools to identify areas needing training or support.
- To collect baseline data on the extent to which technology is currently integrated into forest monitoring for the purposes of future measurement of improvements resulting from the project's interventions.
- To gauge the willingness and readiness of forest supervisors, guards, and local community members to collaborate in technology-enhanced forest monitoring activities.
- To use findings to guide a collaborative design of tailored strategies and interventions that support effective, technology-driven forest monitoring within the forest district.

Method

The project employed a structured questionnaire as the primary data collection tool. This questionnaire included a mix of open-ended and closed-ended questions to capture the respondents' perspectives and ensure a contextual understanding of the issues under investigation. Questions were divided into compulsory and optional categories, with essential information targeted through compulsory questions. This approach ensured that even if optional questions were skipped, evaluators still obtained key insights.

To validate the tool, the questionnaire was pre-tested with a group of forest monitoring personnel. Feedback from this pre-test was used to refine and finalize the questionnaire, which was then programmed into a Computer-Aided Personal Interview (CAPI) format for efficient field data collection. To ensure accuracy and confidence in data collection, enumerators received multiple training sessions. These sessions emphasized the study's goals, use of smart devices for real-time data collection, and appropriate interaction techniques. During the interviews, enumerators engaged respondents in the local dialect while simultaneously translating and recording responses in English.

Since this baseline survey was focused on a single forest district, a census approach was applied. However, not all personnel were accessible during the study period. Respondent selection was organized in layers, with the District Manager aiding in selecting Assistant District Managers, who in turn assisted with selecting Forest Managers and Range Supervisors.

The latter then facilitated the selection of resource guards and forest protection guards. Additionally, forest monitors affiliated with an association of plantation developing individuals and companies known as the Private Afforestation Developer Organization (PADO) and the Women in Timber Ghana, Association (WiTG) were included in the study. In total, 35 respondents participated, and the survey was conducted anonymously to encourage open expression. After data collection, responses were exported from the KoboCollect server to SPSS for comprehensive review, de-duplication, and further cleaning before analysis.

Table 1: Ranges and respondents involved in baseline

No	Range (Forest Reserve Area)	Respondents involved	Survey Locations
1	Opro	District Manager (DM)	Abofour
2	Kwamisa	Assistant District Managers (ADM)	Asempaneye
3	Asufu East	Range Managers	Jaabankrom
4	Asufu West	Range Supervisors	Derma
5	Afram Headwaters	Resource Guards	Anhwerekrom
6	Asubima	Forest Protection Guards	Akumadan
7	Afrensu-Brohuma	Private forest monitors	Kyekyewere
8	Gianima		Offinso
9	Mankrang		

Results

Respondents' demographics

All 35 respondents (100%) were male, reflecting a predominantly male workforce among forest monitoring field officers in the Offinso Forest District. This demographic pattern also suggests a wider gender imbalance in forest management roles within the district which needs to be highlighted for stakeholders to promote gender diversity in such roles. Regarding education, respondents' levels varied significantly, with the largest group (40%) holding tertiary qualifications and another 37.1% having completed secondary education. In essence, a substantial portion of the forest monitoring team has a foundational or advanced level of education, which can support further training and the adoption of improved monitoring practices that the ATEM-OFD project is promoting and seeking to implement.

Table 2: Demographic characteristics of baseline respondents

Variable	Frequency	Percent
Gender		
Male	35	100
Educational level		
No formal	7	20
Primary	1	2.9
Secondary	13	37.1
Tertiary	14	40
Digital literacy skills		
None	6	17.1
Basic	9	25.7
Intermediate	5	14.3
Advanced	15	42.9
Total	35	100

Digital literacy levels also showed considerable variation. Most respondents (42.9%) reported advanced digital skills, while 25.7% had basic skills and 14.3% had intermediate digital literacy. These levels were assessed based on their ability to use smart devices, send and receive emails, utilize messaging apps like WhatsApp, and browse the internet for information. The prevalence of advanced digital literacy among respondents is promising for the adoption of technology-based monitoring tools, as it suggests that a majority have the skills needed for tech-driven fieldwork. However, the varied skill levels suggest that some team members may benefit from additional training to optimize their use of digital tools.

Notably, 17.1% of respondents reported no digital literacy skills, which could limit their ability to fully engage with the project's tech-based interventions. This lack of digital skills appears linked to educational gaps, as a portion of these respondents also had no formal education. This gap could hinder the seamless integration of tech solutions within the district's forest monitoring operations. Addressing this requires targeted training for this subset of personnel to promote inclusivity and ensure that all team members can participate effectively in the enhanced monitoring system.

Knowledge of smart forest monitoring techniques and tools

Respondents were asked whether they were aware of any smart or tech-based forest monitoring techniques and tools, as well as which specific ones they knew. Approximately 66.7% confirmed awareness of such tools, while 33.3% were not familiar with any. The tools most frequently mentioned included drones, satellite imagery, remote sensing, GPS/GIS, and offline mapping apps like Avenza. Half of the respondents (50%) are aware of drones as a monitoring tool, reflecting moderate familiarity with this technology, which has become more widely recognized for forest surveillance and data collection. Furthermore, GPS/GIS tools showed the highest awareness level at 70%, suggesting that respondents are relatively comfortable with geospatial technologies. Satellite imagery awareness

stood at 38.9% whereas awareness of remote sensors was relatively low at 11.1%, indicating that few respondents are familiar with this technology.

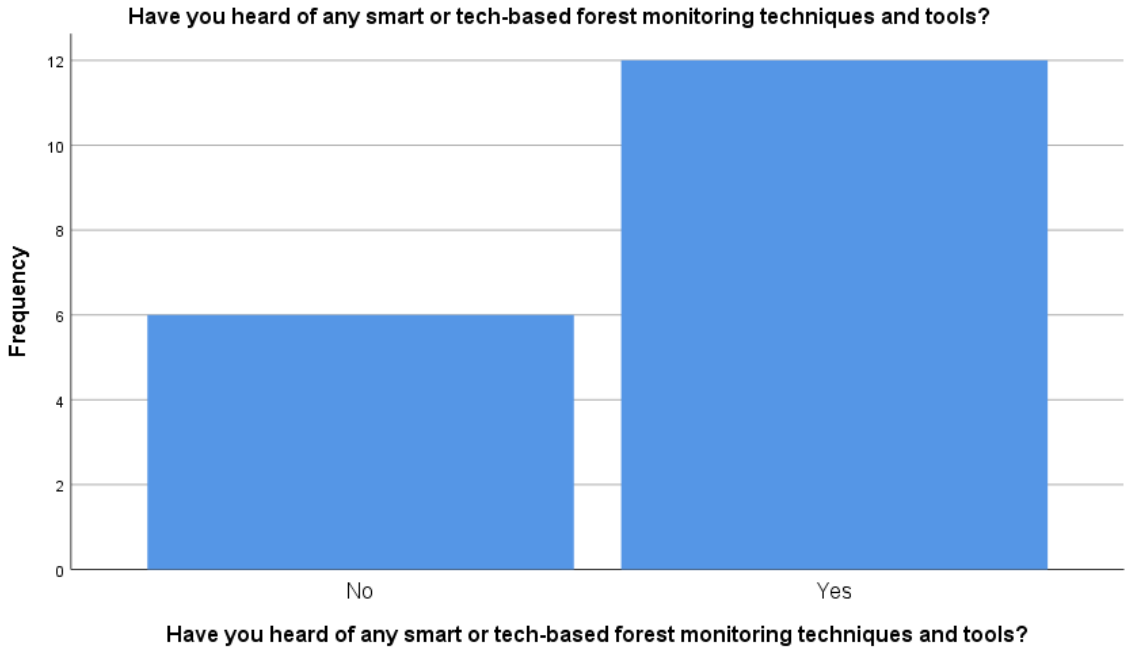


Figure 1: Awareness of smart forest monitoring tools

Only 22.2% of respondents are aware of forest monitoring apps designed for data collection. This limited awareness highlights a potential area for improvement, as these applications can streamline data recording, facilitate real-time alerts, and provide easy access to mapped information, even in offline settings. The Avenza offline mapping app was particularly noted among resource guards, who used it to host PDF maps of their specific areas of interest (ranges), including forest reserves and compartments they manage. However, the app was primarily used for its offline GPS functionality, with limited exploration of other potential features.

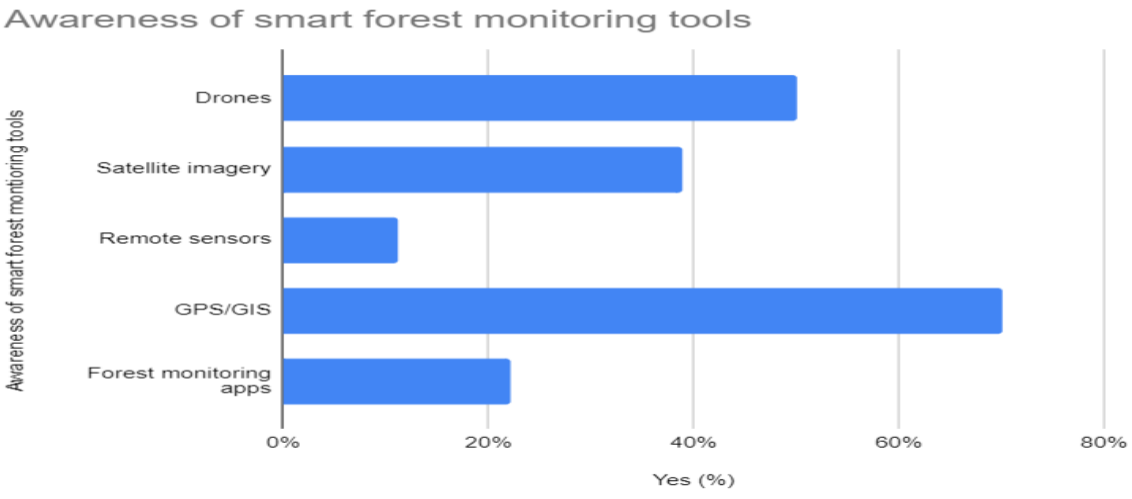


Figure 2: Awareness of specific smart forest monitoring tools

Interestingly, majority of the respondents (83.3%) were not familiar with the Global Forest Watch (GFW) Forest Watcher apps and GFW interactive map and monitoring platform, which offer expanded capabilities for forest monitoring, including near-real-time alerts, enhanced data visualization and streamlines management of forest monitoring teams. However, given the tools' additional functionalities, they could significantly enrich monitoring practices once staff receive appropriate training. Importantly, with respondents' prior exposure to Avenza's basic features, the transition to GFW tools is likely to be smooth, as they already have foundational experience in digital mapping applications. This familiarity should ease the learning curve for integrating GFW's more advanced features into routine forest monitoring activities.

Table 3: Thirty (30) respondents' level of knowledge and application for specific smart forest monitoring tools

Technology	Level of knowledge (usage and application)				
	None	Know about it but cannot operate	Can operate but not take data	Can operate and take data	Can operate, take data and analyze data
Drone	15 (50%)	15 (50%)	-	-	-
Satellite imagery	17 (57.7%)	12 (38.9%)	1 (3.3%)	-	-
Remote sensing	26 (85.6%)	3 (11.1%)	1 (3.3%)	-	-
GPS / GIS	9 (30%)	12 (40%)	3 (10%)	6 (20%)	-
Forest monitoring apps	20 (67.8%)	-	8 (25.5%)	2 (6.7%)	-
Total	30 (100)				
Awareness of GFW monitoring tools (Interactive map & Forest Watcher app)	Yes (%)		No (%)		
	25(83.3%)		5 (16.7%)		
Total	30 (100)				

*Figures in parenthesis are percentages.

A further breakdown of the data (Table 3) reveals that while 50% of respondents are aware of drones, they lack the skills to operate them. Only 3.3% reported knowing how to operate satellite imagery tools, though they cannot generate or extract data with them, while 38.9% are aware of satellite imagery but are unable to use it at all. Regarding GPS/GIS devices, 20% of respondents are capable of both operating the tools and collecting data, while 10% can operate the devices but cannot gather data.

Additionally, 40% of respondents are aware of GPS/GIS technology but lack operational knowledge. Similarly, with forest monitoring applications such as the Avenza offline mapping app, 20% of respondents can operate the app and extract data, while 25.5% are able to operate it but lack the skills to gather data.

In terms of practical use and familiarity, GPS devices and forest monitoring apps like Avenza are more commonly used among the forest personnel, suggesting that these tools are more accessible and will serve as significant entry points for expanding the use of other advanced monitoring technologies like the GFW Forest Watcher apps, which combines GPS and offline mapping features with additional powerful functionalities.

Current practices in forest monitoring in the district

Forest monitoring in the Offinso Forest Services Division District is structured hierarchically. The District Manager oversees the operations, assisted by three Assistant District Managers (ADMs), each responsible for three forest reserves within the district. Reporting to each ADM are forest managers and range supervisors, who are each assigned to specific forest ranges. Each range supervisor is supported by forest resource guards, who serve as frontline staff responsible for direct monitoring. While resource guards are official staff members of the Forest Services Division (FSD), fringe forest protection guards also assist in monitoring. However, unlike resource guards, they are not fully community members enrolled as volunteers or staff but are hired on an as-needed basis. Both resource and protection guards have assigned compartments within designated reserves that they monitor throughout the year. Some compartments also contain legally permitted farms known as “admitted farms,” where smallholder farmers operate within specific guidelines.

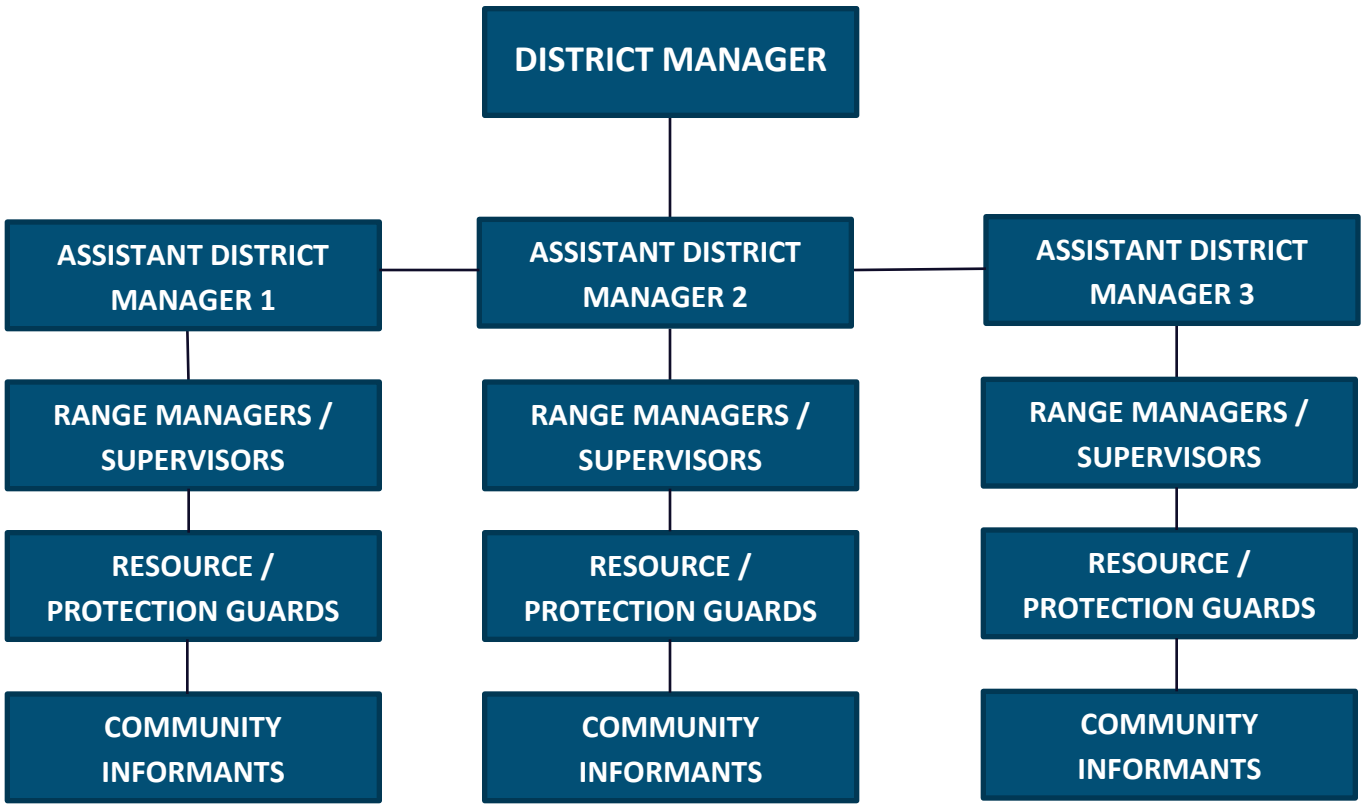


Figure 3: Hierarchy of the forest monitoring framework in the Offinso Forest District

To foster community involvement, range supervisors and resource guards engage local community informants, mostly smallholder farmers from the forest fringe communities. These volunteers, often farming within the reserves under the Modified Taungya System (MTS), act as additional eyes and ears, promptly reporting any violations. When individuals are caught breaching forest laws, resource guards report to their supervisors, who oversee arrests and escort offenders to the police station. Offenders are then processed through the court system, with range managers or ADMs serving as witnesses. Sometimes offenders are jailed or fined up to GHS 2400.00 (equivalent USD 150.00), as permitted by the forest laws. However, legal proceedings often face delays, which demotivates the volunteers and guards whose efforts sometimes go unrecognized due to these prolonged cases.

Field observations revealed significant gaps in the equipment available to frontline forest monitoring personnel, presenting challenges to their effectiveness and safety. Most personnel rely on bicycles and motorbikes mostly fueled by themselves, to conduct their patrols, with some areas of the forest so inaccessible that officers are required to travel on foot. This limited mobility significantly hampers their ability to cover large areas efficiently, especially in remote and rugged portions of the ranges.

Moreover, in their role as protectors of forest resources, these frontline officers face considerable risks. While they are tasked with confronting and deterring offenders, current laws prevent them from carrying firearms, leaving them vulnerable when encountering potentially hostile or violent individuals engaged in illegal activities. The absence of even basic protective equipment, such as tasers or other self-defense tools, further worsens their exposure to danger and undermines their morale and safety.

Table 4: Monitoring routine for field officers in the Offinso Forest District

	Forest Management Activity	Schedule (annual)	Tech-based tools used?	Remarks
1	Reserve boundary maintenance	2 cycles, ongoing	☑	Avenza
2	Greenbelt maintenance	2 cycles, ongoing	☒	
3	Fire belt maintenance	2 cycles, ongoing	☒	
4	Bush fire detection	As and when	☒	
5	Admitted farms boundary maintenance	2 cycles, ongoing	☒	
6	Illegal logging / processing detection	As and when	☒	
7	Illegal mining detection	As and when	☒	
8	Protection against commercial extraction of NTFPs (e.g. snails, rattan, canes, pestles, medicinal plants etc.)	As and when	☒	
9	Pollution of water bodies	2 cycles, ongoing	☒	
10	Infrastructure development	As and when	☒	
11	Animal husbandry / Cattle grazing	As and when	☒	
12	Stock survey	As and when	☒	
13	Pre-harvest checks	As and when	☒	
14	Post-harvest checks	As and when	☒	

Each resource guard is tasked with completing a monitoring cycle of their designated compartment every six months, totaling two cycles per year. During each cycle, they undertake routine management activities such as reserve boundary maintenance, greenbelt and fire belt upkeep, bushfire detection, monitoring boundaries of admitted farms, and identifying illegal logging, mining, or commercial extraction of non-timber forest products (e.g., snails, rattan, medicinal plants). They also

detect pollution, unauthorized grazing, and illegal construction. Although Avenza maps are sometimes used for boundary maintenance, in terms of helping forest resource guards and protection guards to identify and geo-locate their designated compartments, the rest of the monitoring tasks or forest management activities rely heavily on field surveys, physical inspections and manual data recording without modern ICT or tech-based forest monitoring tools.

Perception towards smart forest monitoring tools and techniques

Building on the understanding of digital literacy and the awareness of smart forest monitoring tools, the study further assessed respondents' perceptions of the benefits of these tools and gauged their interest in integrating them into their routine forest monitoring practices. All respondents (100%) expressed a belief that smart monitoring techniques would be beneficial and will enhance their ability to effectively protect and monitor the forest. A key advantage noted was the ability of smart tools to address critical gaps in coverage, particularly since current methods often leave portions of the forest unmonitored after an officer has completed their rounds. This limitation, where incidents may occur unnoticed after a routine patrol, underscores a significant need for technology that can provide more continuous oversight.

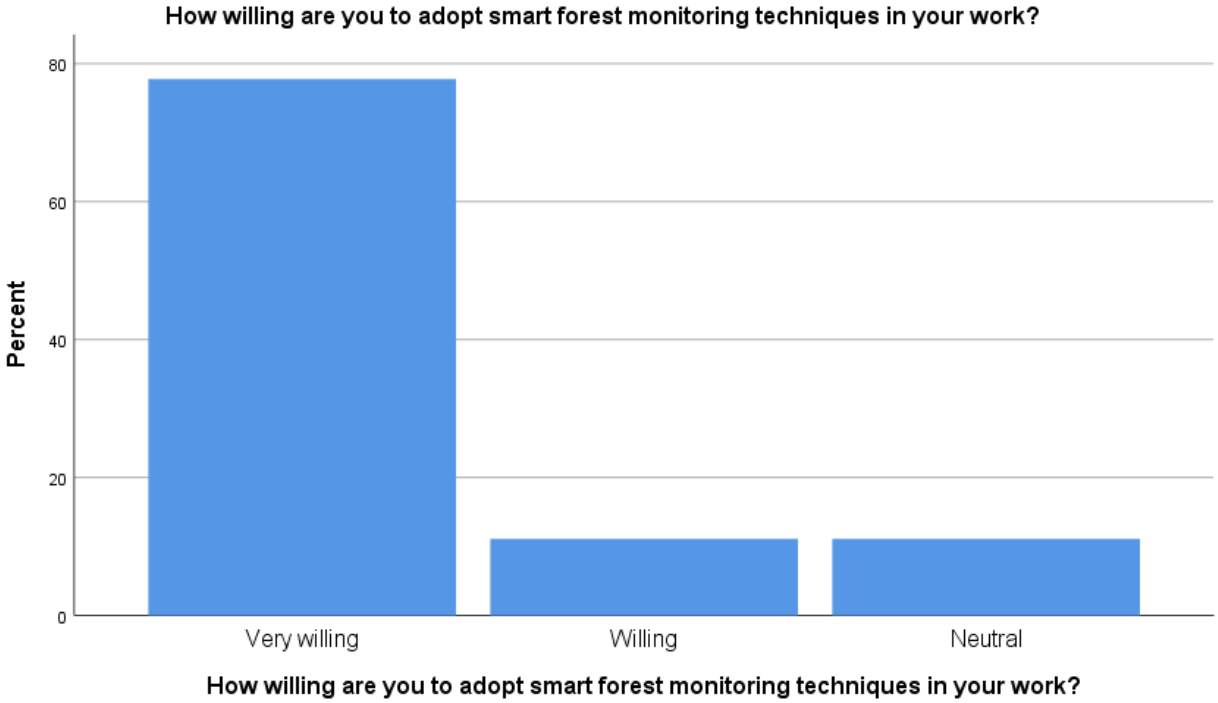


Figure 4: Willingness to adopt smart forest monitoring techniques and tools

Respondents highlighted several other specific benefits, including the potential for near real-time monitoring, which would allow them to react more promptly to forest infractions. The alert systems associated with these tools were seen as a way to boost safety and give field officers better preparation and situational awareness before arriving at incident locations. Additionally, many pointed

out that using technology for monitoring could be more time-efficient, thereby reducing the strain of manual patrols and allowing for a broader area to be covered more frequently and effectively.

Overall, there was strong willingness for adopting these techniques, with 77.8% of respondents indicating they were 'very willing' to integrate smart forest monitoring tools into their work routines. Another 11.1% expressed a willingness to adopt the tools, while the remaining 11.1% were neutral. This positive response reflects a readiness among field officers to leverage technology for enhanced forest conservation and also acknowledging that proper training and continued support will be essential to achieve full integration and effective usage.

Table 5: Perception of forest management practices that can be aided with smart tools

	Forest Management Activity	Tech-based tools used?
1	Reserve boundary maintenance	☑
2	Greenbelt maintenance	☑
3	Fire belt maintenance	☑
4	Bush fire detection	☑
5	Admitted farms boundary maintenance	☑
6	Illegal logging / processing detection	☑
7	Illegal mining detection	☑
8	Protection against commercial extraction of NTFPs (e.g. snails, rattan, canes, pestles, medicinal plants etc.)	☒
9	Pollution of water bodies	☑
10	Infrastructure development	☑
11	Animal husbandry / Cattle grazing	☒
12	Stock survey	☒
13	Pre-harvest checks	☒
14	Post-harvest checks	☒

As shown in Table 5, respondents identified several forest management and monitoring activities that could significantly benefit from the integration of smart forest monitoring tools. For reserve boundary maintenance, they believe deforestation alerts from monitoring apps can notify field officers of any breaches, enabling timely interventions to restore boundary integrity. By receiving spatial updates on unwarranted breaks in boundary lines, field officers can better track encroachment and address boundary repairs promptly. Similarly, greenbelt and fire-belt maintenance could be optimized by using spatial assessment tools that detect where Cassia trees or other greenbelt species have not survived, allowing quick action to maintain these critical natural boundaries that protect against fires and encroachment.

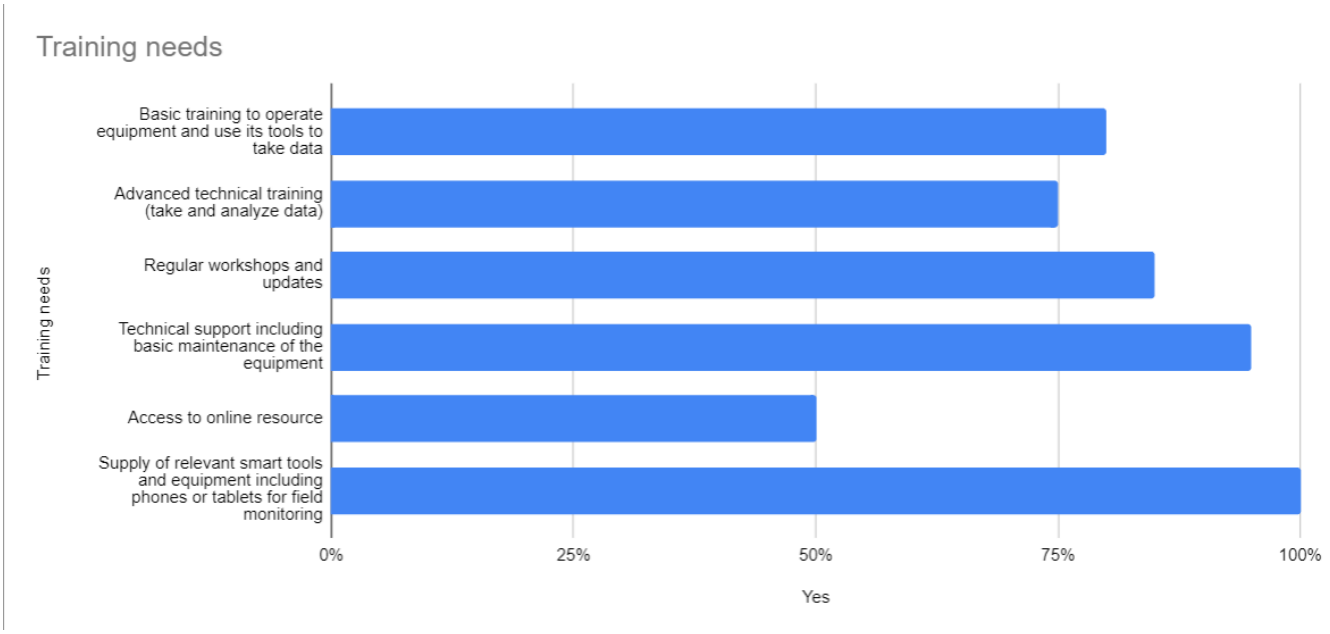
Bush fire detection and prevention was also highlighted as an area where smart monitoring tools could provide transformative support. Near-real-time alerts can notify forest staff of fire outbreaks, facilitating swift responses to contain fires and minimize damage. For admitted farm boundary maintenance, deforestation alerts triggered by any expansion beyond legally marked farm boundaries could help monitor and manage these areas more effectively, ensuring farmers adhere to boundary agreements. Additionally, tools such as shapefiles or polygons can visually mark these areas, making it easier to identify any unauthorized changes.

The respondents also noted that smart tools could improve monitoring of illegal activities, such as logging, mining, and infrastructure development, where deforestation alerts could flag unauthorized land use changes in real-time. This capability is especially critical for water pollution detection, where spatial assessments might reveal increased turbidity or color changes, indicating possible contamination.

Training and support needs

In exploring the types of training and support needed to effectively integrate smart forest monitoring techniques, the responses reveal a clear prioritization of practical, hands-on support, with a strong focus on ensuring operability, accessibility, and sustainability of the tools in the field. The highest priority, indicated by all 35 respondents (100%), is for the *supply of relevant smart tools and equipment*, such as phones or tablets, which are key for data collection and real-time monitoring. As observed on the field, field officers are ill-equipped to use smart tools into current routine monitoring operations. Supplying them with such devices underscores a critical need among respondents to have access to the necessary digital devices as a foundation for using smart monitoring techniques effectively.

Additionally, *technical support*, including basic equipment maintenance, was requested by 95% of respondents. This preference suggests the recognition of the challenges associated with maintaining digital devices in rugged field conditions and the need for ongoing support in troubleshooting and maintaining equipment to ensure longevity and reliability. With 85% of respondents favouring *regular workshops and updates*, there appears to be clear demand for ongoing learning, which would ensure that forest personnel remain informed of advancements and are able to adapt to new functionalities as technology evolves.



In terms of skill acquisition, 80% of respondents requested *basic training* on operating equipment and using tools to collect data, while 75% showed interest in *advanced technical training* to analyze data. These responses reflect varying interests based on levels of digital proficiency among the respondents. In one breath, some respondents are seeking foundational skills whereas others desire

more sophisticated knowledge for data analysis. That calls for project implementers to design tiered training programmes to provide basic operation skills for beginners and advanced technical skills for those ready to engage with more complex data analysis tasks.

Lastly, *access to online resources* was selected by 50% of respondents, pointing to an interest in remote learning aids or references that can support them as they become accustomed to smart monitoring tools. Although this option received lower interest compared to other support areas, it highlights the importance of accessible resources for continuous, self-paced learning, especially in cases where personnel may be in remote locations with limited access to in-person training.

Conclusion and recommendations

This baseline study reveals the current state of digital literacy, technological awareness, and equipment needs among forest personnel in the Offinso Forest District, giving a picture of the readiness of forest personnel in the district to integrate smart forest monitoring tools and techniques. The findings reveal both opportunities and challenges that, if addressed systematically, could enhance forest monitoring effectiveness and safeguard the district's forest resources more efficiently.

The survey shows a mix of basic and advanced digital literacy skills among respondents. Although many personnel are familiar with essential digital tools such as GPS/GIS devices and mobile applications, there remains limited awareness of other advanced smart forest monitoring tools, such as drones, satellite imagery, and remote sensors. The lack of exposure affirms an important knowledge gap that could impact the district's adoption of sophisticated monitoring techniques if not addressed with targeted training and support.

A pressing need for equipment supply and training emerged as a significant finding, which complements the need for basic training to operate the equipment and gather data. Respondents anticipate significant benefits from incorporating smart forest monitoring tools, which they believe will facilitate real-time monitoring, improve safety, and allow for more effective resource allocation. They cited instances where traditional monitoring schedules create gaps in coverage and leave areas vulnerable once officers move on. Smart tools, they assert, would close these gaps by allowing for remote updates and alerts, which could signal unauthorized activities even when personnel are not physically present. Other benefits noted include improved safety through advance alerts, which help officers prepare for potentially dangerous situations, sallowing them to manage their extensive monitoring areas more effectively.

Despite the current knowledge gaps and equipment needs, forest personnel expressed strong enthusiasm for adopting smart forest monitoring tools. This positive sentiment implies that the forest personnel have a proactive attitude toward enhancing their roles, an attitude that guarantees high likelihood of successful tool adoption when accompanied with proper training and resources.

That notwithstanding, some key barriers to implementation include limited digital literacy skills among a portion of personnel, a lack of hands-on experience with advanced monitoring tools, and a gap in access to ongoing technical resources. While current practices rely heavily on field surveys, physical inspections and manual data collection, these methods are labour-intensive and less effective in

combating dynamic threats like illegal logging and bush fires. Without targeted interventions to bridge these gaps, the district may struggle to achieve its full potential of smart monitoring.

Recommendations for implementation

1. A phased approach to adopting smart forest monitoring is recommended, beginning with the immediate supply of essential equipment and intensive foundational training, followed by regular follow-up workshops, advanced technical training, and reliable ongoing technical support.
2. Ensuring consistent support from both institutional and external sources is vital to sustaining engagement among personnel and embedding these tools into routine operations effectively.
3. There is significant potential to scale up this project beyond the Offinso Forest District to other forest districts across Ghana, many of which face similar constraints in forest monitoring.