Electronic Green Journal
Volume 1, Issue 47

Associating Management Effectiveness Scores to Conservation Activities: A Study of Gbele Resource Reserve, Ghana

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Abstract

The study was designed to understand how the Management Effectiveness Tracking Tool (METT) scores in a Protected Area (PA) were influenced by conservation activities. Data was collected from documents on major conservation activities of the PA. Conservation outputs indicators of annual numbers of patrols organized, mammal and Roan Antelope observed, illegal activities recorded, offenders arrested, and livelihood beneficiaries were related to the METT scores in Spearman correlation tests. There were no statistically significant relationships between each of the METT elements and number of patrols, mammals and Roan Antelope observations. However, illegal activities, offenders arrested, and livelihood beneficiaries strongly correlated positively with all the elements. Again, Pearson correlation tests among patrols, illegal activities and mammals observed were not statistically significant. The findings indicate the PA socio-economic benefits to communities was positive. However, management must eliminate illegal logging that suggestively caused decline in mammal observations ($\overline{X}$=2895.6, Std.=867.7, Range=2507).

Introduction

National parks, wildlife reserves and other conservancies are set aside as Protected Areas (PAs) in countries to host representative samples of natural ecosystems for biodiversity conservation. These sites are selected and established as PAs to serve for *in-situ* conservation of species, ecosystems and cultural heritage of the host countries. According to Stolton and Dudley (2016) the International Union for Conservation of Nature (IUCN) describes a protected area to be a clearly defined, recognised, managed space set aside legally or through other effective means to specifically protect and maintain biological diversity. Increasingly, the goals of established PAs do not only have to meet definitive standards but also to stimulate viable biodiversity enterprises that promote socio-economic growth (Lopoukhine et al., 2019).

Various terminologies and categorizations are assigned to PAs. However, the most common categorization are the six different types given by the IUCN (Stolton and Dudley, 2016). Although PAs have highly restrictive regimes in terms of resources

utilization and human interactions allowed, there are shades of levels of human interactions and economic activities permitted (Shafer, 2015). The level of human interactions and economic activities permitted are contingent on the validity of the biodiversity resources found in the PA and their socio-economic importance to the key stakeholders. In effect, the designation and objectives of a PA determine the management regimes put in place to regulate biodiversity utilization and the level of human interactions that could be allowed (Dudley and Phillips, 2006), albeit the ecological integrity of the place should not be compromised.

The demands for biodiversity conservation ideals and socio-economic development pose challenges to the management of protected areas. This is particularly true because PA benefits are anticipated to meet the expectations of diverse stakeholders (Stolton and Dudley, 2015). Thus, the disenchantment with the different stakeholders' demands and expectations of PA benefits range from local community members who feel they have been deprived of their rights to utilize biodiversity resources to merchants who think economic resources are being held without any utilitarian benefits. The utilitarian expectations of local communities and merchants, however, contrast the non-consumptive expectations of PA managers and conservation financiers directed towards positive biodiversity conservation outcomes (Hockings, Stolton, Dudley, and Deguignet, 2018).

Due to the difficulty in meeting alternating expectations of the different stakeholders, illegal utilization of biodiversity resources occurs in PAs (Coad et al., 2015; Tranquilli et al., 2014). Although sometimes natural phenomena like climate change negatively affect biodiversity conservation outcomes, occurrences of illegal activities including poaching, logging and collection of Non-Timber Forest Products (NTFPs) in PAs present greater negative outcomes on management effectiveness (Belokurov et al., 2009). The above challenges have prompted measures to monitor PA management effectiveness to ensure positive biodiversity outcomes while sustainably promoting the other expected benefits.

PA Management Effectiveness Tools' Impacts on Conservation Outcomes

According to Hockings et al. (2018) the World Commission on PAs defines management effectiveness as

'…the assessment of how well an area is being managed – primarily the extent to which it is protecting values and achieving goals and objectives', p. 6. Safeguarding management effectiveness is a key requirement for receiving funding from some donors such as the Global Environmental Facility (GEF) (Burgess et al., 2014; Belokurov et al., 2009). Biodiversity conservation could also be justified before policy makers with higher effective management scores particularly in the era where the Aichi targets for the Convention on Biodiversity (CBD) have been promoted (Leverington et al., 2008).

There are several Protected Area Management Effectiveness (PAME) tools that have been developed to track progress. However, the two most applied tools are the Management Effectiveness Tracking Tool (METT) and the Rapid Assessment and Prioritization of Protected Area Management (RAPPAM) tool (Hockings et al., 2018). The differences in the application of these two tools lie with the number of protected areas under consideration for assessment. The RAPPAM tool is recommended for

assessing protected area network systems in bioregions or within a country while the METT tool is suitable for assessing one protected area. This study evaluated biodiversity conservation output/outcomes in a protected area in Ghana after the METT had been applied for a decade.

The METT tool is more useful when it is applied in the same protected area for a period to enable comparisons to be made to track progress (Hockings et al. 2018). The METT score, just as other PAMEs of the IUCN, is made up of six complementary elements that work together for assessing management effectiveness (Coad et al., 2015; Hockings et al., 2018). The elements are context, inputs, planning, processes, outputs and outcomes of conservation management activities. The METT has thirty main questions with some having sub-questions. The tool uses a score card-based system with answers ranked in an ordinal scale. There are four options ranging from the lowest (zero) to the highest (three). Assessors are required to subjectively select an option with a chance to make comments to explain the reason for their choice. The total score is 100%, therefore a PA with a higher score is reasonably deemed to be effectively managed.

The METT has been criticized for its inadequacies that do not advance for rigorous scientific analysis to understand real conservation impacts (Coad et al., 2015). The authors mentioned the tool basically relies on subjectively ordinal scores focusing on management processes and not strongly on conservation outcomes. Some other weaknesses of the METT assessment score is the potential for bias due to self-assessment made by managers who would like to portray their PAs as effectively managed. More so, many of the assessments are only done once and as such does not yield good data to measure progress (Belokurov et al., 2009; Hockings et al., 2018). Scholars have recommended the need for conducting counterfactual assessment on METT scores in order to ensure that assessors' grades really reflect the situation on the ground (Burgess et al., 2014; Coad et al., 2015). Other scholars like Hockings et al. (2018) recommended that METT assessment should be done together with different stakeholders of the PA to allow for deliberations before choices are made to answer questions to reduce bias. Assembling a team to assess the METT is also useful in retaining institutional memory for subsequent assessments particularly when there is attrition of personnel.

This study evaluated the METT assessment on the management effectiveness of the Gbele Resource Reserve in Ghana. The protected area has been a beneficiary of funding from the Ghana Sustainable Land and Water Management Project (GSLWMP) from 2011 to 2020. The project was funded from the Global Environmental Facility sponsored by the World Bank. It was therefore obligatory for the PA to be assessed under the METT as it is a demand for all GEF funded projects (Hockings et al., 2018). The assessment spanned a decade where annual achievements were pitted against target scores.

The purpose of this study is to associate the progressive changes in the scores of the elements to conservation interventions and their outputs/outcomes experienced under the project implementation. Although a few studies on METT assessment in PAs

have been carried out using global databases, the details behind the scores have not been studied. This research sought to contribute in filling that gap. That is to understand how major interventions carried out in the PA influenced the METT scores. The study's assumption is: An implementation of project interventions increased assessors' scores on corresponding METT elements but not necessarily how the initiatives impacted on biodiversity conservation output/outcomes (Coad et al., 2015).

These five research questions were asked for the study.

1. Which of the METT elements were associated with the major project interventions' objectives?
2. What livelihood programs were introduced and who were the beneficiaries?
3. How did the project interventions influence the assessors' scores of the elements?
4. How did: (I) patrols undertaken and number of mammals observed, (II) patrols undertaken and illegal activities recorded and (III) mammals observed and illegal activities recorded relate statistically?
5. How did the scores assigned to the METT elements statistically relate with the number of: (I) patrols organized, (II) mammals observed (III) Roan Antelopes observed (IV) illegal activities recorded (V) offenders arrested and prosecuted (VI) beneficiaries of livelihood programs?

Material and Methods

This study relied on reports, project documents and field observations of management interventions in the Gbele Resource Reserve for data. The study design was set on the project interventions' influences on the METT scores achieved for the PA and its associated impacts on biodiversity conservation.

Study Area

The Gbele Resource Reserve https://ghanawildlife.org is in an area of Guinea savanna vegetation in the Upper West Region of Ghana. Geographically, the PA is situated between latitude 10° 22' N and 10° 44' N and longitude 2° 03' W and 2° 12' W (The Wildlife Division, 2018). It covers an area of 565 km^2 and its perimeter is 126.1 km. Oppong and Woebong (2015) stated the most abundant tree species found in the reserve are *Vitellaria paradoxa, Pterocarpus erinaceus, Anogeissus leicarpus, Mitragyna innermis* and *Combretum collinum*.

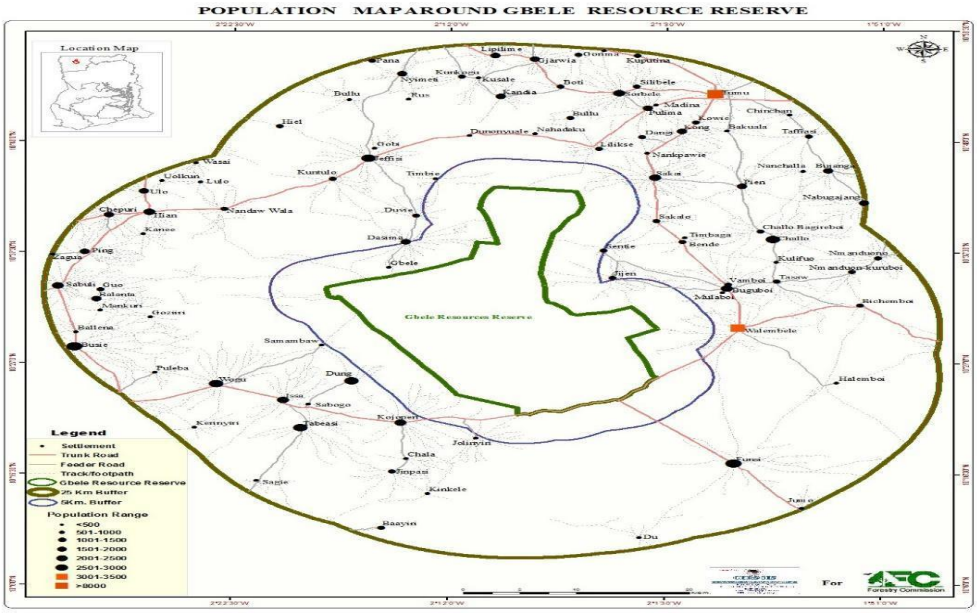

Figure 1. Study area and surrounding communities. Source Wildlife Division.

Various observations and short-term research work have recorded 34 species of mammals, 13 species of reptiles and over 194 species of birds in the PA (The Wildlife Division, 2018). Commonly observed mammal species include Warthogs *(Phacochoerus aethiopicus),* Waterbuck *(Kobus defesa),* bushbuck *(Tragelaphus scriptus),* Roan Antelope (*Hippotragus equinus)* and Patas Monkey (*Erythrocebus patas).* The avifauna species of special interest include Willcocks's Honeyguide (*Indicator willcocksi),* the rare Gambaga Flycatcher (*Muscicapa gambagae)* and the Black-headed Weaver (*Ploceus melanocephalus).*

Methods

Data was taken from METT assessment forms, management plans, work plans and field reports together with field observations to determine the PA core values and objectives as well as to assess the project's interventions and their impacts on conservation outputs/outcomes between 2010 and 2019. Data on project budgetary allocations was not included in the results presentation because its full complement was not available. It was only the recurrent budget that was sent directly to the PA, while equipment and other large expenditures earmarked for infrastructure construction were centralized at the project secretariat.

Desktop study

Law enforcement is an important management activity in PAs. Patrols are regularly organized to deter and to arrest offenders in PAs (Coad et al., 2015; Hockings et al., 2018; Shafer, 2015). The Gbele Resource Reserve (GRR) keeps data on patrol

records. The GRR throughout the project applied global positioning system (GPS) and management information system (MIST) software to enable supervisors to analyze illegal activities, monitor biodiversity and assess staff performance https://smartconservationtools.org. The georeferenced data taken on all observed medium to large mammals and all illegal activities sighted during foot patrols by GPS were entered into the MIST for analysis.

Monthly cumulative patrol data for each of the ten years was compiled for analysis. That is cumulative data for number of patrols organized, number of medium to large mammals observed, number of illegal activities recorded and the number of offenders who were arrested and prosecuted at the courts were collected. Since the Roan Antelope is a totemic animal for the PA and its conservation serves as one of the PA's core values, its observation was isolated for study. Also, data on livelihood interventions and the number of beneficiaries was collected. The study's purpose was to understand how changes in the scores of the METT elements relate to the conservation outputs/outcomes of patrols organized, mammal sightings, records of illegal activities, and livelihood beneficiaries.

The METT Assessment of the Gbele Resource Reserve

The METT scores assessments were conducted in a three-tier approach to reduce bias (Coad et al., 2015; Hockings et al., 2018). The PA manager and his two assistants, together with his immediate supervisor, conducted the assessments through discussions in a one day meeting for each of the ten years. Scores for land and water use planning (items 21a to 21c) were based on management interventions undertaken in collaboration with the District Department of Agriculture in the communities fringing the PA. Items 22 and 23 were eliminated because they were not applicable (this PA has no major commercial entities or indigenous peoples around).

The scores were sent to the Wildlife Division headquarters in Accra each year for vetting by the senior officer who was in charge of the GSLWMP implementation. His role was to evaluate the scores in relation to the interventions carried out and the biodiversity conservation outputs/outcomes in the PA for the year under assessment. The approved score was then transferred to the Project Coordinating Unit (PCU) for further assessment. The filtering processes for the assessment and the annual field verification visits by the project financiers promoted the counterfactual verification requirements as recommended by scholars like Burgess et al. (2014) and Coad et al. (2015).

There have been different versions of the METT assessment tool, including GEF 6, the version used in this study. The assessment segregated the cumulative scores of the six complementary elements of context, planning, inputs, processes, outputs, and outcomes for each year for analysis (Hockings et al., 2018). Since conservation outcomes take a longer period to be realized (Coad et al., 2015), outputs and outcomes scores have been combined in the data analysis. Table 1 shows the METT elements and a summary of the items that were used for assessment.

Table 1: GEF 6 METT tool elements and items used to assess GRR

Context	Planning	Inputs	Processes	Outputs/Outcomes
1. PA legally gazetted	7 a-c: Additional planning issues	9. PA Resources inventory	3. Law enforcement	10. Protection systems
2. PA regulations appropriate 4. PA Managed with objectives	7. PA management plan	13. Adequate staff numbers	6. Boundary demarcation	25. Economic benefits to local people
5. PA design (size and shape)	8. PA prepares regular work plan	14. Staff training	11. Research application	27. Visitor facilities
	21. Land and water planning	15. PA Current budget	12. Resource management	30. Biodiversity condition
	21 a-c: Land and water planning issues	16. Security of budget	17. Budget management	
		18. Sufficient equipment	19. Equipment maintenance	
		29. Fees application into management	20. Education and awareness	
			24. Local communities involvement	
			24 a-c. Impacts on local communities	
			26. Monitoring and evaluation	
			28. Commercial tourism	

Source: Hockings et al., (2018)

The author of this article was part of the group of officers who conducted the METT assessment for the PA for the period under study. A METT score target was set for the PA by the project secretariat in the annual work plan for each of the years under study. An assessment was done at the end of each year to track progress. Table 2 shows METT targeted and attained scores by the GRR for the period. The 2010 score served as a baseline before project interventions were carried out.

Table 2: METT targeted and attained scores by the GRR for the study period.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Targeted %	45	50	55	60	65	70	75	80	80	80
Attained %	45	50	54	59	67	74	75	75	76	79

Source: GSLWMP secretariat

Data Analysis

Data was analyzed with SOFA statistical software and Microsoft excel. Findings have been presented in charts and tables with descriptive and inferential statistical analysis. The main objectives of each of the project interventions have been logically connected to its corresponding METT elements to describe how the initiatives influenced the scores.

The study used a Pearson correlation test to relate quarterly patrol numbers, mammal observations, and illegal activities with each other. The Pearson test was appropriate to understand how guards' efforts related to the indicative conservation outputs/outcomes of patrols organized, illegal activities recorded and mammals observed. Also, a Spearman correlation statistics test was used to relate each of the METT elements scores to the annual number of: (1) patrols organized, (2) illegal activities recorded, (3) offenders arrested and prosecuted, (4) mammals observed, (5) Roan Antelopes observed and (6) beneficiaries of livelihood programs. The Spearman correlation test was appropriate because the scores of the elements are ordinal (Self, 2017). Except stated, a significance level of 5% was used in all statistical tests.

Results and Discussions

The data sheet of the METT scores and the management plan document indicated the Gbele Resource Reserve has three core values. These are: (1) sustainable use of natural ecosystem, (2) protect the iconic Roan Antelope (*Hippotragus equinus*) and (3) protect the Kulpawn River basin. The PA designation falls under class VI of the IUCN protected area categorization. The two key objectives are: (1) to regulate the utilization of wildlife resources and (2) to facilitate research for continuous wildlife development. Results presentation begins with the association of specific METT elements with the objectives of the project's interventions

Major Interventions of the GSLWMP in the PA

Biodiversity conservation activities like law enforcement, boundary clearing, and conservation education have been carried out before the project's interventions in the PA began. However, just as Leverington et al. (2010) stated, "PAs improve their management effectiveness when they are under a funded project", the GSLWMP interventions structured law enforcement activities in the PA with a dedicated budget.

From Table three (below), context was associated with interventions that directly took place in the PA or had legislative implications on the PA or biodiversity

management. Planning was connected to all project interventions, although on two occasions there was an obvious closeness between this element and the interventions. Associating planning with all the interventions is in line with the assertions of Campese and Sulle (2019) and Leverington et al. (2010), which indicated that planning plays a major role in all biodiversity management effectiveness assessment methodologies. Inputs and processes were associated with all interventions to indicate that they were procured/promoted to assist resource management procedures to reduce or eliminate threats that affect biodiversity conservation outputs/outcomes (Leverington et al., 2008). Also, outputs/outcomes were associated with all interventions because they were initiated to produce a certain level of positive impact for biodiversity conservation (Hockings et al. 2018).

Table 3: Major project interventions carried out in the PA between 2011 and 2019.

Intervention	Year Initiated	Major Objectives	Associated METT elements	Outputs from the Intervention
Supply of ration	2011	● effectively deploy guards ● boost guards morale	Inputs, planning, processes and output/outcomes	On average, 27 PA guards received monthly assorted foodstuffs since inception.
Boundary clearing	2011	● ward off encroachers ● build community relationship ● create firebreaks	Context, planning. input, processes and output/outcomes	On average, 26 community members (males) have been hired annually to clear boundaries for a fee.
Tracks construction and maintenance	2011	● enhance patrol activities ● promote game viewing	Context, planning, inputs, processes and output/outcomes	35.1 Km of tracks constructed/maintained.
Vehicle procured	2011	● promote supervision and enhance law enforcement	Input, planning, processes and output/outcomes	One Nissan Pick-up procured to promote law enforcement supervision.
Conservation education and collaborative resource management	2012	● create biodiversity conservation awareness ● create local biodiversity conservation structures for	Context, planning, input, processes and output/outcomes	Conservation committees set up in 20 communities to promote local resource governance for socio-economic development.

		economic benefits		
Ecological monitoring and MIST data collection	2012/ 2013	● monitor biodiversity for decision making ● monitor patrol activities of field guards ● collect ecological data	Context, planning, input, processes and output/outcomes	Data analysis on guards' performance, mammal observations and illegal activities done monthly for adaptive management.
Supply of personal field gears	2013	● promote effective patrols in safety ● boost guards morale	Input, planning, processes and output/outcomes	35 sets of personal protective uniforms that lasted for three years after being supplied.
Resources inventory	2014	● understand resources status to feed into management plan	Context, planning, input, processes and output/outcomes	Report on the status of the PA fauna and flora in the milieu of human socio-ecological stances produced.
Wildfire management training	2014	● reduce the incidence of uncontrolled bushfires ● increase unburnt areas	Input, planning, processes and output/outcomes	32 PA guards trained and up to 50 ha of unburnt areas achieved since 2015.
Organic Shea nut gathering	2015	● promote economic benefits for local communities ● build strong community relations	Inputs, planning, processes and output/outcomes	Generate an annual average income of USD 16,150 for about 535 women gatherers since inception. Four Shea nuts storehouses were constructed.
Provision of accommodation for guards	2016	● effectively deploy guards ● boost guards morale	Input, planning, processes and output/outcomes	20 existing room units renovated and 11 new room units constructed.
Management plan development	2016	● situate PA management in a framework to achieve biodiversity	Context, planning, input, processes and output/outcomes	The PA management plan was completed in 2018 and it is due for review in 2023.

		conservation with other positive outcomes		
Construction of tourism facilities	2018	● promote game viewing for positive biodiversity conservation and socio-economic outcomes	Context, input, planning, processes and output/outcomes	Game viewing platform and a weir for water holding was constructed.
Table 3 continue				
Intervention	**Year Initiated**	● **Major Objectives**	**Associated METT elements**	**Outputs from the Intervention**
Provision of watering facilities for livestock	2018	● reduce wildlife-livestock interactions to limit possible transfer of zoonotic diseases ● build strong relationship between PA management and local communities ● promote socio-economic development in local communities	Input, planning, processes and output/outcomes	Water holding dugouts constructed in six vantage communities surrounding the PA.
Guards training on law enforcement and safety	2019	● promote law enforcement effectiveness ● boost guards morale	Input, planning, processes and output/outcomes	25 patrol guards out of the 34 permanent staff of the GRR underwent law enforcement and safety training.

Source: Author

Supplementary Livelihood Programs and Beneficiaries

The 34 PA permanent guards on the Government of Ghana payroll were not beneficiaries of the livelihood programs introduced by the project and therefore are not part of this analysis. Creating biodiversity related livelihood benefits for the local

communities is in line with the PA core values and its two objectives. See Figure two for annual livelihoods programs hosted and their beneficiaries in the PA.

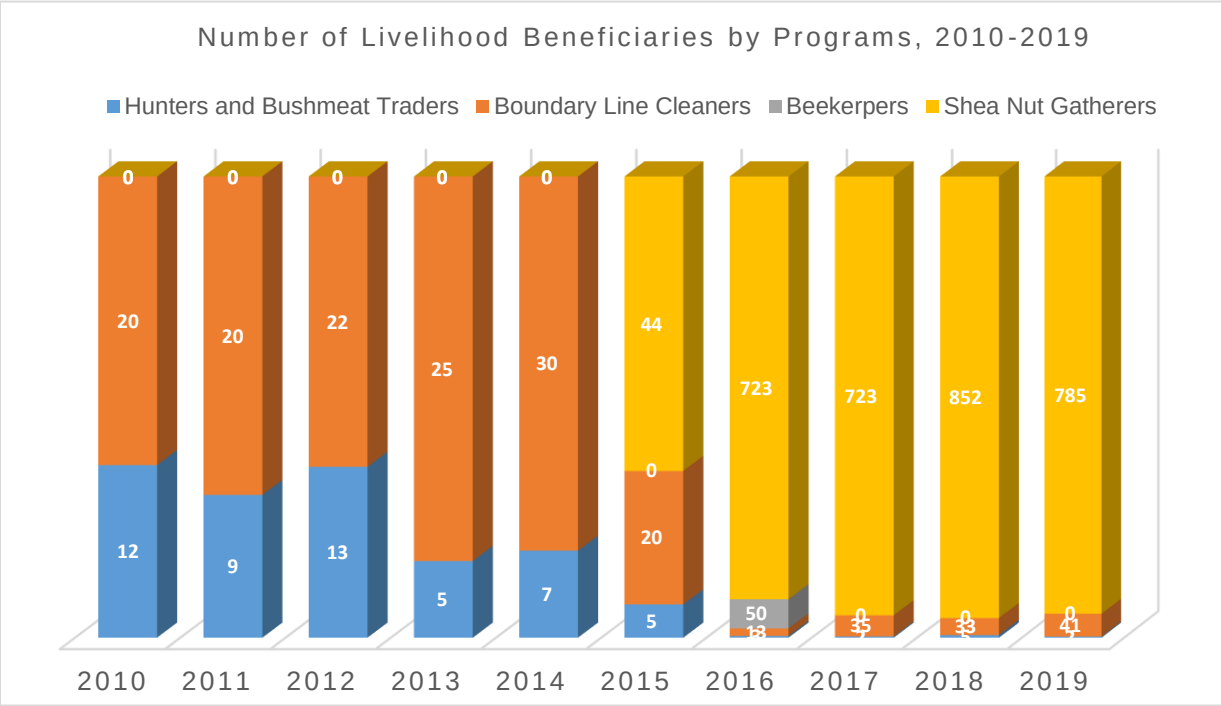

Figure 2: Livelihood beneficiaries between 2010 and 2019. Source: Author

The four livelihood programs identified were supplementary to agriculture which is the main economic activity of the local people. They included bushmeat/hunting, boundary line clearing, beekeeping and organic Shea nuts *(Vitellaria paradoxa)* gathering. The livelihood programs hosted were gender biased. Bushmeat trade and Shea nut gathering are largely done by females whereas hunting, boundary line clearing and beekeeping beneficiaries were males. Nonetheless, bushmeat trade and hunting had existed before the project inception.

The livelihood programs introduced by the PA have both consumptive and non-consumptive values (Levington et al., 2008). Organic Shea nuts gathering introduced in 2015 has consumptive value and yet it could be argued for as the most sustainable livelihood program among the four (Lovett, 2004). The inputs from the PA for the organic Shea nuts livelihood program were creating awareness on the trade and linking gatherers to a buyer as well as providing annual certificates to authenticate the source of the nuts as organic to the buyer. Storage houses have been constructed in four major gathering communities.

Although scholars like Brooks, Waylen and Mulder (2013) argued marketing tools do not always work well in sustainable biodiversity conservation, so far, the organic Shea nut gathering has provided the largest beneficiaries which chiefly target vulnerable women (Laube, 2015; Moore, 2008). However, its impact, for example, in reducing

poaching is yet to be assessed. The other livelihood programs like boundary line clearing has no direct consumptive value on the biodiversity resources of the PA, but it largely depends on funding availability. Importantly, the PA leverages on the livelihood programs to build community relationships that also reinforce the all-important law enforcement activities for biodiversity conservation (Singh et al., 2020).

Project Interventions and their Influences on Assessors' Scores

This section relates to the study's assumption. Annual scores for all six elements of the METT improved, especially in a subsequent year after major interventions were implemented (see Figure 3). Annual percentage scores were used for each element (Belokurov et al., 2009).

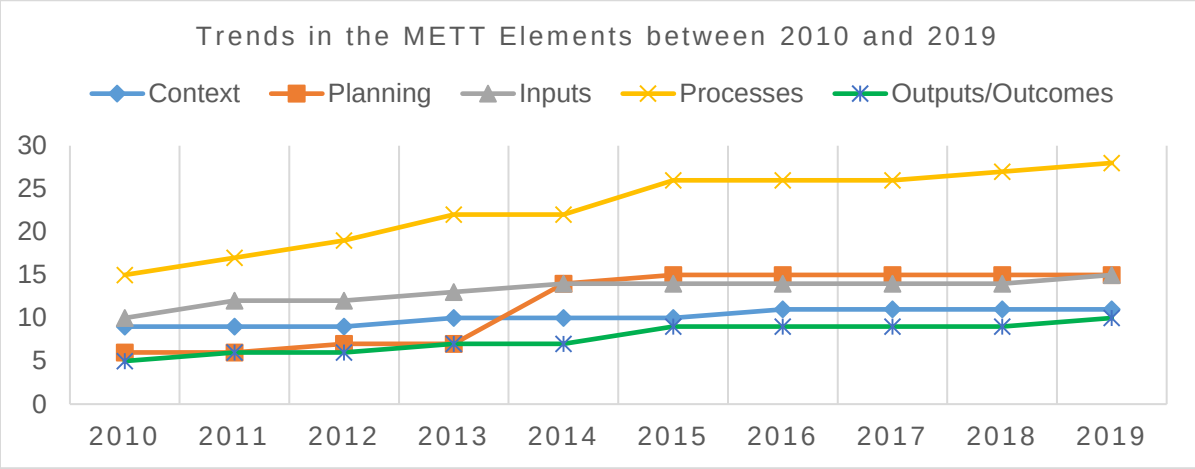

Figure 3: Annual cumulative scores of the METT between 2010 and 2019.

Source: Author

Scores for context did not change much with a maximum score of 11% out of a possible 12% ($\overline{X}$=10.2, Std.=0.8, Range=2.0). The only item that brought change relates to management objectives. A change in this item score peaked at 3% in 2016 after ecological monitoring and resource inventory were initiated in 2012 and 2014 respectively. PA legal status and regulation appropriateness did not change because even in 2010 they were scored at 3%. The limiting item (scored at 2%) under context is the PA size and design with the explanation that the northern end appears narrow—with an edge effect that disturbs animal distribution in a milieu of limited land use planning on the adjacent lands. Biodiversity conservation concerns are prioritized over possible negative local community impacts in establishing protected areas, and this is reflected in scoring the items under context. Similar findings were made by Belokurov et al. (2009) and Leverington et al. (2010), where they reported that, usually, items under context meet strong management effectiveness criteria for legally established PAs.

Planning scores began to change when annual work plan development and its implementation became a regular feature in 2011, which improved the 2012 score. The other items' scores under planning such as ecological monitoring and evaluation

improved through the MIST application in 2013 as well as resource inventory for management plan preparation in 2014. The planning score maintained its possible peak of 15% ($\overline{X}$=11.5, Std.=4.3, Range=9.0) from 2015 although the PA management plan was published in 2018. This finding agrees with Leverington et al. (2010) verdict that showed except for management plans scoring weakest under planning in most PAs, other items under the element score higher. Peaking planning scores before the full complement of having a management plan indicates higher scores were assigned when an intervention began, but not essentially when a full application had been achieved or its impacts evaluated. Admittedly, it takes considerable inputs such as first conducting socio-ecological surveys to have effective management plans prepared to manage PAs (Campese and Sulle 2019; Leverington et al., 2008).

Major input interventions were initiated to facilitate biodiversity conservation processes. Improvement in input scores began in 2012 after a pick-up vehicle was purchased and ration had become part of the PA monthly expenditure from 2011. Interventions like MIST implementation and supply of field gears to guards in 2013 influenced a higher score of 14% in 2014, which remained the same until 2019 when training activity for guards shifted the score to 15% ($\overline{X}$=13.0, Std.=1.5, Range=5.0). The possible highest score under input is 27% but due to limiting items including fees (scored 1%) not being plied back into conservation activities at PA levels in Ghana, scores remained just above half of the possible mark for the study period. Essentially, inputs procured were to reduce threats to biodiversity conservation from local communities. The argument then would have been to put in more to support the local communities to reduce threats levels however, like a Leverington et al. (2010) report, input interventions that relate to community benefits always scored lower than those that directly benefit biodiversity conservation or PA guards. Except for budget security and resource inventory scores that peaked at 3%, all the other items' scores were limited to 2% after 2013.

Processes have the largest number of items and their scores improved to the highest point of 28% out of the possible 33% ($\overline{X}$=22.8, Std.=4.5, Range=13.0). In 2010, the processes score was 15%, and this moved to 22% in 2013. The jump in the score for 2013 was largely influenced by the introduction of structured ecological monitoring data collection in 2012. This intervention changed the scores of these items that fall under this element: Law enforcement, boundary demarcation, and resource management as well as monitoring and evaluation. All these items peaked in 2013. In 2015, it shot up again to 26% because of the resource inventory and wildfire management training interventions in 2014. In 2018 the score was 27% and PA impacts on local communities peaked due to expansion in organic Shea nuts gathering in 2017. Also, education and awareness that created the Shea nut gathering score reached a maximum in 2016. Construction of a game viewing platform, which began in 2018 and was completed in 2019, moved the score to 28%.

Items under processes scored higher in this study, unlike a Leverington et al. (2010) study that items like monitoring and evaluation, benefits to local communities as well as research application in PA management effectiveness scored poorly. However, in this study structured livelihood programs like organic Shea nut gathering and the

MIST for ecological monitoring, respectively, improved scores for benefits to local people and monitoring and evaluation. It can be stated that these interventions mitigated the uncontrolled overdependence on biodiversity resources and other threats caused by people with lower human development indices which eventually leads to lower PA effectiveness scores in developing countries (Geldmann et al., 2019).

Although scores for all items under processes improved, five limiting items were kept at 2% each for the study period. They were budget management, research application, equipment maintenance, commercial tourism and involvement of local communities in PA management. Respectively, the first four limiting items mentioned above were related to inadequacies in human resources and infrastructure at the PA level. Also, local communities' involvement in PA management scores were limited at 2% just as Hockings et al. (2018) and Leverington et al. (2010) mentioned this item usually scores poorly in management effectiveness assessments. However, a 2% score out of a possible 3% for an item under this study could be considered relatively high, particularly as the reports indicated that community resource management committees have been established in 20 fringe communities of the PA.

The output/outcomes score was 10% out of a possible 12% ($\overline{X}$=7.7, Std.=1.7, Range=5.0). Biodiversity condition scores have remained constant at 2% from the study's inception to 2019, which largely was due to inadequate scientific data for proper assessment. This score was cautionary, as Hockings et al. (2018) reported that inadequate biodiversity data is a bane to effective management of most PAs. Although there had not been major changes in visitor numbers for the study period, the visitor facility score reached 2% in 2015 after considerable access track construction began in 2011. Protection systems and economic benefits to local people peaked at the end of 2019. Physical infrastructure constructed either for the direct benefit of the PA or for fringe communities (like the six water holding dugouts) influenced the scores of these items. Long term assessments of the infrastructure impacts, like how the water holding dugouts would reduce livestock entry into the PA or their contribution to livestock rearing in the local communities, are required to understand their bearings on biodiversity conservation outcomes (Coad et al., 2015).

Patrols Organized, Mammals Observed and Illegal Activities Recorded

Different types of patrols are organized. There are day and night patrols where guards return to base camp after working for some hours, as well as extended patrols where guards stay beyond a day (usually five to seven days and nights) on the field before returning to base camp. Annual cumulative data on the number of patrols organized, illegal activities recorded and the number of mammals observed for the study period are shown in Figure 4. However, for the Pearson correlation tests quarterly recordings were used to determine the relationships. There were fluctuations in both mammal observations ($\overline{X}$=2895.6, Std.=867.7, Range=2507) and number of patrols organized ($\overline{X}$=686.2, Std.=179.3, Range=556.0) for the study period. Illegal activities recorded ($\overline{X}$=44.8, Std.=31.6, Range=95.0) indicated a general increase in detection after 2014 but reduced sharply in 2019.

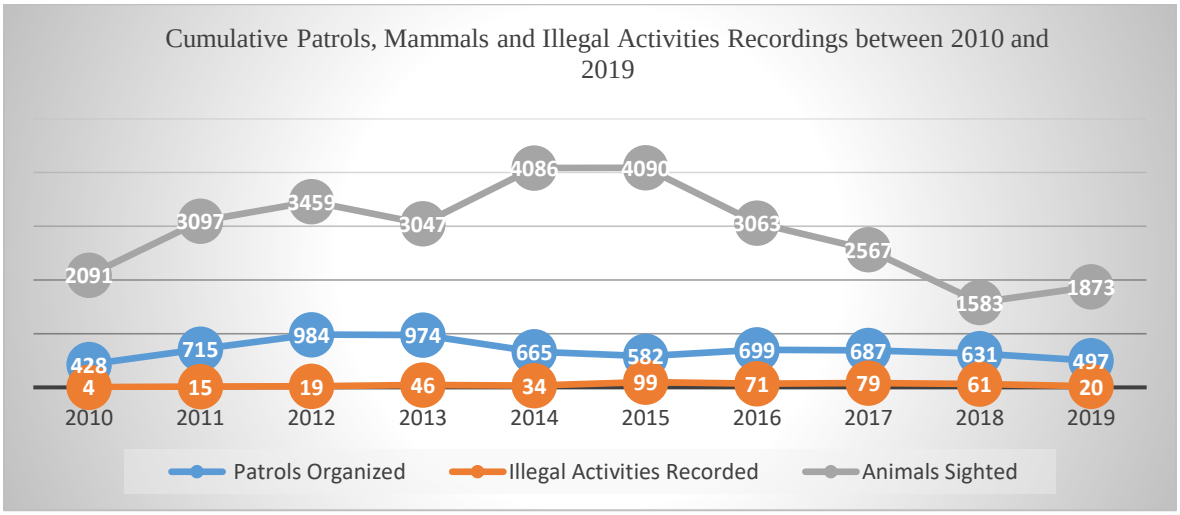

Figure 4: Annual cumulative patrols, mammals and illegal activities recordings.

Source: Author

The best number of patrols organized was in 2012 with 984 patrols which was largely promoted based on the ecological data collection introduced in that year. However, with the implementation of the MIST in October 2013, patrols were structured unlike the ad hoc operations in the previous years. The structured patrols coupled with the ecological data collection promoted adaptive management principles which made patrols more purposeful with senior management supervision. Also, the introduction of the MIST and construction of access tracks enabled patrols to be conducted into deeper portions of the PA with long hours which were hitherto infrequent. This obviously led to detection of more illegal activities which then showed a general decline after 2015 (Figure 4). This observation is like the Kablan et al. 2017 and Frankfurt Zoological Society (2014) reports which showed that consistent patrol efforts eventually reduce poaching incidences, cognizant of the fact that guards usually counteract poachers' efforts in areas with higher animal concentrations in PAs (Lotter and Clark, 2014). See appendix A.

The highest mammal observation yearly total was in 2015 with 4090, followed by 2014 with 4086, although these were not the best years for the number of patrols organized. After the peak mammal observations in 2015, numbers declined consistently to its lowest in 2018 with 1583 observations. A Pearson correlation test between the number of patrols organized and mammal observations was not statistically significant but showed a very weak positive correlation ($p=0.66$, $r=0.07$, $df=38$). The very weak positive correlation between the variables is at the back of the early increases in both variables and then the generally fluctuated patrol numbers after the increase. The result attests to the Kablan et al. (2017) findings that established patrol efforts must be within a certain threshold of number of days per square kilometer in a period before species observation would reach statistically significant levels.

A Pearson correlation test between mammals observed and illegal activities recorded was not statistically significant but showed a weak positive correlation ($p=0.22$,

r=0.20, df=38). Whereas mammal observations showed a general decline after 2015, illegal activities recordings fluctuated over the study period but tilted to a decline. It can be debated then that it was not just the number of illegal activities detected that might have had effects on the decline of mammal observations, but rather the category of the threats and the concentration of patrols were extremely important in mammal observations. For example, 2015 had the highest number of recorded illegal activities (99) yet, it is the year the highest mammal observations occurred. Nonetheless, mammal observations started to decline when a more degrading threat of illegal logging (Tranquilli et al., 2014) began in 2016.

Two kinds of illegal activities were recorded in this study. They were poaching and logging. Leverington et al. (2008) described respectively, poaching and illegal logging as posing direct and indirect threats to wildlife species. Poacher arrests and poaching indicators like gunshots, spent cartridges, traps, poachers' footprints/camps and poachers escaped were the commonly recorded illegal activities before 2016. However, reports from the Gbele Resource Reserve indicated between 2016 and 2018, close to half of the illegal activities recorded were for a new indirect threat of illegal logging of rosewood (*Pterocarpus erinaceus*). This menace was particularly rife in 2017 and 2018 and as Tranquilli et al. (2014) reported, illegal logging and agriculture are the most important threats to wildlife species. Thus, the illegal logging of rosewood could explain the declines in mammal observations experienced between 2016 and 2019.

The negative impacts of illegal logging on the declines in mammal observations relative to organized patrols for the period could be described on two fronts. First, the illegal logging deflected guards' attention to that particular threat and, in an attempt to curb the menace, the well-structured patrol regimes with its ecological monitoring principles planned with the MIST in 2013 were disrupted. Secondly, the logging incidences obviously caused habitat destructions (Tranquilli et al., 2014) that suggestively together with direct poaching (Loupkhine et al., 2012) unsettled the animal populations, consequent to fewer mammal observations. Indicatively, the elimination of the threat by the end of 2018 stopped the decline and mammal observations began to increase for the first time in 2019 after 2015.

Again, a Pearson correlation test between patrols organized and illegal activities was statistically not significant but showed a very weak positive correlation (p=0.42, r=0.13, df=38). The two variables' annual frequencies did not show any pattern but rather fluctuated within a certain range. Tranquilli et al. (2014) and also Frankfurt Zoological Society (2014) attributed causes of illegal activities in PAs to inadequacies in guards' numbers, ineffectiveness on patrols, and insufficient equipment as well as guards' low-level motivation. These items were limited in the METT scores in this study. These notwithstanding, the biological properties and economic values of the resources targeted for poaching and logging (such as rosewood) likewise account greatly for increasing illegal activities and their detection by guards (Lotter and Clark 2014; Singh et al., 2020).

Conservation Outputs Relationships with the Annual METT Elements' Scores

Spearman correlation tests between annual conservation outputs and the annual METT element scores were conducted. There were no statistically significant relationships between each of the elements and the conservation indicative outputs of number of patrols organized, mammals and Roan Antelope observations. With the exception of planning versus Roan Antelope which showed a very weak positive correlation, there were negative correlations between each of the elements and the indicative outputs. The correlation tests results are shown in Table four below.

The results indicate that the improved scores of the METT elements did not match positively with the conservation indicative outputs. The Spearman correlation tests results in this study contrasted a Coad et al. (2015) hypothesized example, stating that increased PAME scores should lead to positive outcomes to underpin management effectiveness. The desired conservation outcome was to achieve positive correlations between each element and the indicative conservation outputs particularly relating to cumulative mammal observations in this study.

The very weak positive correlation between planning scores and Roan Antelope observation emanates from the gradual increases in the element scores which peaked at 15% in 2015 whereas the species observations also increased to its highest of 63 in 2015 before the decline began in 2016 with fluctuations. The peaking of planning scores halfway through the project period could be inferred from Washington, Baillie, Waterman and Milner-Gulland (2014) report. The authors stated that at the initial stages of conservation projects, planning and input strategies become focal issues rather than outputs/outcomes. The positive correlation test between planning and the species observations could then be attributed to chance. Although the Roan Antelope is acknowledged to be the focal species of the PA, conservation strategies are the same for all mammal species in the PA.

Table 4: Spearman Correlation Matrix between Conservation Outputs and METT Elements

	Patrols Organized	Mammals Observed	Roan Antelope Observed	Illegal Activities Recorded	Offenders Arrested	Livelihood Beneficiaries
Context	p= 0.98, r= -0.01	p= 0.15, r= -0.49	p= 0.69, r= -0.15	p= 0.02, r= 0.70	p= 0.06, r= 0.61	p= 1.637e-3, r= 0.86
Planning	p= 0.73, r= -0.12	p= 0.07, r= -0.59	p= 0.91, r= 0.04	p= 7.165e-3, r= 0.79	p= 0.08, r= 0.58	p= 6.680e-4*, r= 0.89
Inputs	p= 0.49, r= -0.25	p= 0.29, r= -0.37	p= 0.91, r= -0.04	p= 0.09, r= 0.57	p= 0.12, r= 0.52	p= 6.441e-3, r= 0.79
Processes	p= 0.54, r= -0.22	p= 0.05, r= -0.64	p= 0.48, r= -0.26	p= 0.08, r= 0.57	p= 0.17, r= 0.47	p= 4.346e-4*, r= 0.90
Outputs/ Outcomes	p= 0.62, r= -0.18	p= 0.09, r= -0.55	p= 0.73, r= -0.13	p= 0.06, r= 0.62	p= 0.12, r= 0.52	p= 4.346e-4*, r= 0.90

df=8, * significant at 1%. Source: Author

Illegal activities and offenders arrested strongly correlated positively with all the METT elements. However, it was only between illegal activities and context as well as planning that the relationships were statistically significant. These findings give hope that the project interventions that improved all the elements' scores also enhanced illegal activities detection and curbing by arresting and prosecuting offenders. Structured patrols with the MIST ecological monitoring procedures, rations and other guards' morale boosting interventions introduced could account for the detection and arrest of offenders in the PA. This is in line with the Kablan et al. (2017) recommendation for consistent patrol efforts with proper ecological monitoring to enable mammal populations to recover in areas that suffer from declines. The PA should adhere to its structured patrol regimes to reduce threats that cause mammal observation declines.

There were statistically significant relationships between all the elements and the number of livelihood beneficiaries. The very strong positive correlation and highly significant levels of the tests results indicate the assessors' belief that the PA was impactful on the local communities with socio-economic benefits is factual. However, it will take a considerable period before a proper evaluation of the interventions' impacts on positive biodiversity conservation could be assessed (Coad et al., 2015). The results contrasted scholars like Belokurov et al. (2009) and Leverington et al. (2010) reports suggesting that community benefits scores are always the weakest in effectiveness assessment. The interventions hosted were not only to provide supplementary livelihood opportunities to the local people, but they were meant to build strong community bonds with PA management such as securing a reliable informant base that promotes law enforcement activities in the PA. Nevertheless, a balance should be found between livelihood benefits and law enforcement in the PA in adherence to the Geldmann et al. (2019) admonition that indicated that livelihood programs could lead to illegal use of biodiversity if not properly managed.

Conclusions

The purpose of this study was to associate the annual progressive scores of the METT to conservation interventions and their outputs/outcomes experienced under the Ghana Sustainable Land and Water Management Project implemented in the Gbele Resource Reserve between 2010 and 2019. The study was to understand the basis behind the METT assessment scores for the PA. Project interventions focused on direct benefits to biodiversity conservation in the PA and local community welfare. The findings indicate corresponding METT elements scores changed positively in a subsequent year after which an intervention was implemented. The interventions' objectives associated satisfactorily with the METT elements.

There were no statistically significant relationships in Pearson correlation tests between organized patrols and mammal observations as well as between illegal activities and organized patrols. Also, a Pearson correlation test between mammal observations and illegal activities was not statistically significant. Illegal logging of rosewood suggestively showed to have had a more serious impact on the mammal observations decline after 2015 than other forms of poaching. The illegal logging both

disrupted structured patrol regimes and destroyed habitats to unsettle mammal populations and impede observations.

There were no statistically significant relationships between each of the METT elements and the conservation outputs of the number of patrols organized, mammal observations and Roan Antelope observations. There were negative correlations between each of the elements and the outputs except for planning versus Roan Antelope, which showed a very weak positive correlation. The very weak positive Spearman correlation between planning and observations of the species could be attributed to chance because the species does not receive any more special conservation management than the other mammals of the PA. The results indicate that the improved scores of the METT elements generally did not match positively with the conservation indicative outputs.

Illegal activities and offenders arrested strongly correlated positively with all the METT elements; however, except between illegal activities and planning, none of the relationships were statistically significant. These findings suggest the project interventions that informed the METT scores really enhanced illegal activities detection and arrest of offenders. Also, there were statistically significant relationships between all the elements and livelihood beneficiaries. The very strong positive correlation and highly statistically significant levels of the Spearman correlation results indicate that the PA's impact on the local communities with socio-economic benefits is factually related to the higher corresponding METT scores.

The GSLWMP interventions really improved management effectiveness of the Gbele Resource Reserve, however with the project coming to an end, will the GRR be able to fund the structured patrols that hinged on the MIST application? A post GSLWMP intervention assessment of impacts on biodiversity conservation in GRR has to be undertaken to help design future project interventions in Ghana. For example, a study on how the water holding dugouts constructed would be able to reduce livestock entry into the PA or their contribution to livestock rearing in the communities has to be undertaken.

This research has shown that the application of the METT assessment tool combined with an application of technology promotes management effectiveness of protected areas. It is recommended for the Wildlife Division of Ghana to adapt the METT tool with a dedicated budget in all its protected areas to promote their management effectiveness.

Acknowledgement

The author would like to thank Mr. Fredua Agyeman, Mr. Isaac Charles Acquah Jr., Mr. Charles Christian Amankwah, Mr. Kingsley Kwako Amoako and Miss Ivy Lomotey of the GSLWMP for the METT data used for this study.

Declaration of Conflict of Interest

The author declares no conflict of interests in research, authorship and publication of this article.

Funding

The author received no financial support in research, authorship and publication of this article.

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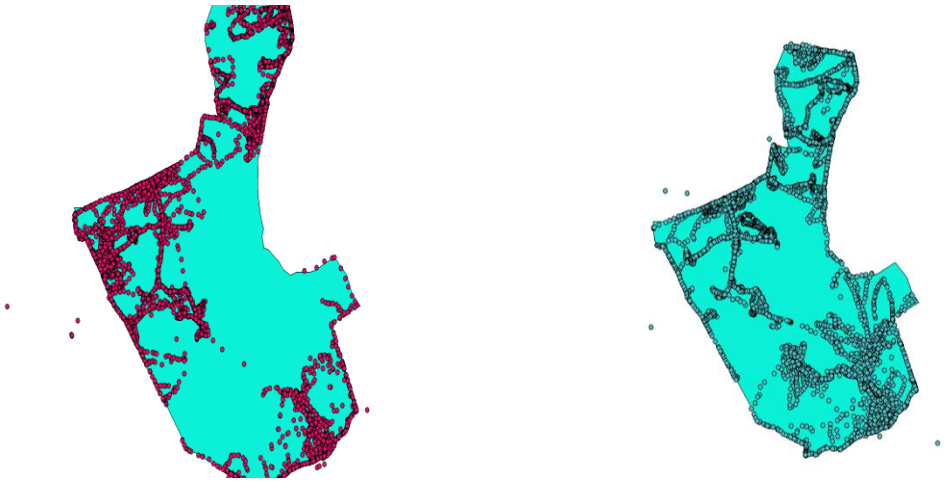
Appendix A

Ecological Monitoring and Law Enforcement Efforts for 2016 and 2017 Displayed in the MIST.



2016 2017

- Intense ground coverage in 2017 was necessitated by heightened supervision to address illegal rosewood logging and construction of more access tracks.