

Improving Monitoring and Evaluation of Performance using spatial Data Case Study GWL

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Key words: Monitoring and Evaluation, KPI, Spatial data, Geographic Information Systems, Ghana Water Limited (GWL).

SUMMARY

Monitoring and evaluation (M&E) plays a crucial role in assessing the effectiveness and sustainability of utility operations. However, the impact of development work has often been inadequately measured and evaluated due to the lack of quick and simple spatial data visualization tools within Geographic Information Systems (GIS) integrated with statistical analysis capabilities. This paper explores the potential of combining M&E and GIS to enhance communication and decision-making processes within the context of Ghana Water Limited (GWL). M&E is primarily focused on monitoring changes and results over time, while GIS is spatially oriented, determining the geographic distribution of outcomes. By integrating these two perspectives, a powerful tool can be created to visualize and analyze relevant project or operational data, supporting project and operational success evaluation.

The paper traces the historical development of M&E-GIS integration, highlighting early pioneers like Dr. John Snow, who used maps to analyze the cholera outbreak in London in 1854. This seminal work paved the way for the integration of cartographic techniques and thematic mapping in studying geographically dependent phenomena.

The objective of this paper is to address strategies for incorporating GIS into the M&E processes of GWL, enhancing effective communication and decision-making. GIS provides an interface between databases and digital maps, enabling spatial analysis and delivering information efficiently to stakeholders. By tying data to specific locations, GIS empowers organizations to answer the 4W questions (What, Where, When, and by Whom) effectively.

Through a case study of GWL, the paper explores the benefits of integrating GIS into M&E processes, such as improved data visualization, spatial analysis capabilities, and enhanced communication of operational outcomes to diverse stakeholders. The paper aims to contribute to the development of a comprehensive M&E-GIS framework for effective monitoring, evaluation, and communication within the urban water sector in Ghana.

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1. INTRODUCTION

The mechanisms established by businesses to enhance their management of outputs, outcomes, and impact are collectively referred to as monitoring and evaluation (Evaluation Office & United Nation Development Programme, 2002). It entails keeping track of progress, evaluating results, and comprehending how projects and operational activities affect the target population (Irfan et al., 2021).

Monitoring is the process of gathering data and measuring how well a program is doing toward its goals. A program's interventions are evaluated on a regular basis to see if they have changed the desired outcomes (Dawn Robert & Nidhi Khattri, 2012). M&E (Monitoring & Evaluation) is a valuable tool targeting two key elements to any development project or operational activity's effectiveness and sustainability (Banu, 2018).

The impact of development work has not, however, been efficiently and effectively measured and evaluated due to work implementation plans that do not include quick and simple graphical spatial data visualizations within a Geographic Information System (GIS) with integrated statistical tools (Australian Aid, 2020). One of the best ways to communicate results in a way that many people from different backgrounds can understand is to employ spatially enhanced M&E. A location component makes up eighty percent (80%) of all data on the planet (KOMESLI & AKILLI, 2018).

Using statistical tools of graphs and charts cannot completely and effectively portray what the data says. Spatial analytics or GIS mapping provides a highly visual means to extract this missing analytic and ensure that the clearest possible view of your data or result is presented (Australian Aid, 2020). By adding map visualization to project implementation systems, Location Analytics enhances their functionality. There is enhanced insight into project or operational data, without disruption to usual information workflow. Location Analytics delivers the missing perspective to usual project information flow (Australian Aid, 2020).

How can M&E and GIS work together?

1.1 How to integrate M&E and GIS

M&E is temporally focused, monitoring changes and results occurring over time, whereas GIS is spatially oriented, determining where the outcomes are occurring. This is the key distinction between M&E and GIS (Ndedi & Nisabwe, 2017).

The task is to combine these two opposing points of view into a single tool that will show relevant data in support of the projects or operation activities's success. How significantly depends on the data chosen for the project or operational activity monitoring. It must be pertinent and meaningful.

1.2 History of M&E-GIS development (Case Studies)

Before developing computers and technical names for processes, maps were used in monitoring and assessment systems. Dr. John Snow was one of the early adopters in 1854 and used points on a map to show the locations of individual cholera fatalities to illustrate a cholera outbreak in London. Dr. Snow made the claim that the Broad Street Pump, a tainted water pump whose handle he had removed to stop the cholera outbreak's spread, was the disease's origin after studying the distribution of cholera deaths. The John Snow map was distinctive because it used cartographic techniques to not only represent but also study groups of geographically dependent phenomena, even though the fundamental components of topography and theme had been used in mapping before (Tulchinsky, 2018).

GIS is a technical tool that connects databases and digital maps in the restricted sense. By providing an interface between the data and a map, GIS expands the scope of information technology to include geographic spatial analysis. As a result, it is simple to deliver information to important decision-makers fast, effectively, and efficiently. All data is then tied to a location, making it simple to respond to the 4W questions of What, Where, When, and by Whom (ESRI, 2023).

The objective of this paper is to address ways GIS can be integrated into the M&E of GWL for effective communication in support of the M&E processes.

2. METHODS

The methodology started with an office reconnaissance to identify the performance indicators being used within the organization before integrating traditional M&E with spatial data.

Digitalization of the various business processes leading to achieving the Performance Indicators (PIs) was then done. Under this process, the various spatial and non-spatial data existing currently were Identified for data and process modelling to be done. To ensure the existence of connectivity built between the spatial and non-spatial data, various relationships between them were mapped out.

To ensure that the implemented linkages were functioning as intended, the modeled datasets were then analyzed and visualized.

The different performance indicators were introduced, and their performance was tested using models based on each indicator's input parameters.

The modelled data relationships and database was then used to design and develop an M&E dashboard incorporating each of the PIs and the various monitoring metrics.

The dashboard was then extended with mobile versions of M&E field validation system.

The System was tested with data from selected departments as well as the M&E validation metric.

3. RESULTS AND DISCUSSION

The study on "Improving Monitoring and Evaluation of Performances using Spatial Data in the context of Ghana Water Limited" has resulted in the development of an M&E (Monitoring and Evaluation) dashboard integrated with geospatial data for each of the Key Performance Indicators (KPIs) monitored by the Corporate Planning, Monitoring and Evaluation Department. This dashboard is a custom-developed web and mobile-based platform that provides a comprehensive and user-friendly interface for tracking and analyzing the company's performance.

The dashboard features a robust user login access control system (Figure 3.1) that ensures secure access and manages user rights and permissions, ensuring that sensitive data is accessible only to authorized personnel.

Figure 3.2 showcases the reports section, where users can view various Performance Indicators, their targets, and the actual performance for a specific snapshot period and department within the utility. This feature allows for easy monitoring and analysis of performance trends, enabling data-driven decision-making and timely course corrections.

The dashboard also provides insights into the operations department's planned and unplanned maintenance activities on the distribution infrastructure (Figure 3.3). This section highlights the risk levels associated with the distribution system based on historical reports, enabling proactive maintenance planning and efficient resource allocation.

Additionally, Figure 3.4 presents a comprehensive overview of the water production status at various treatment plants during the reporting period. This feature allows for real-time monitoring of production levels, facilitating efficient operations and ensuring a reliable water supply.

The M&E dashboard's integration with geospatial data enables spatial analysis and visualization, providing a deeper understanding of performance patterns and trends across different geographic regions. This spatial component enhances decision-making processes by allowing for targeted interventions and resource allocation based on specific location-based needs.

Overall, the M&E dashboard developed by the Ghana Water Limited represents a significant stride towards improving monitoring and evaluation practices, leveraging the power of spatial data and cutting-edge technology to drive operational excellence and ensure efficient service delivery.



Figure 3.1 User login Interface

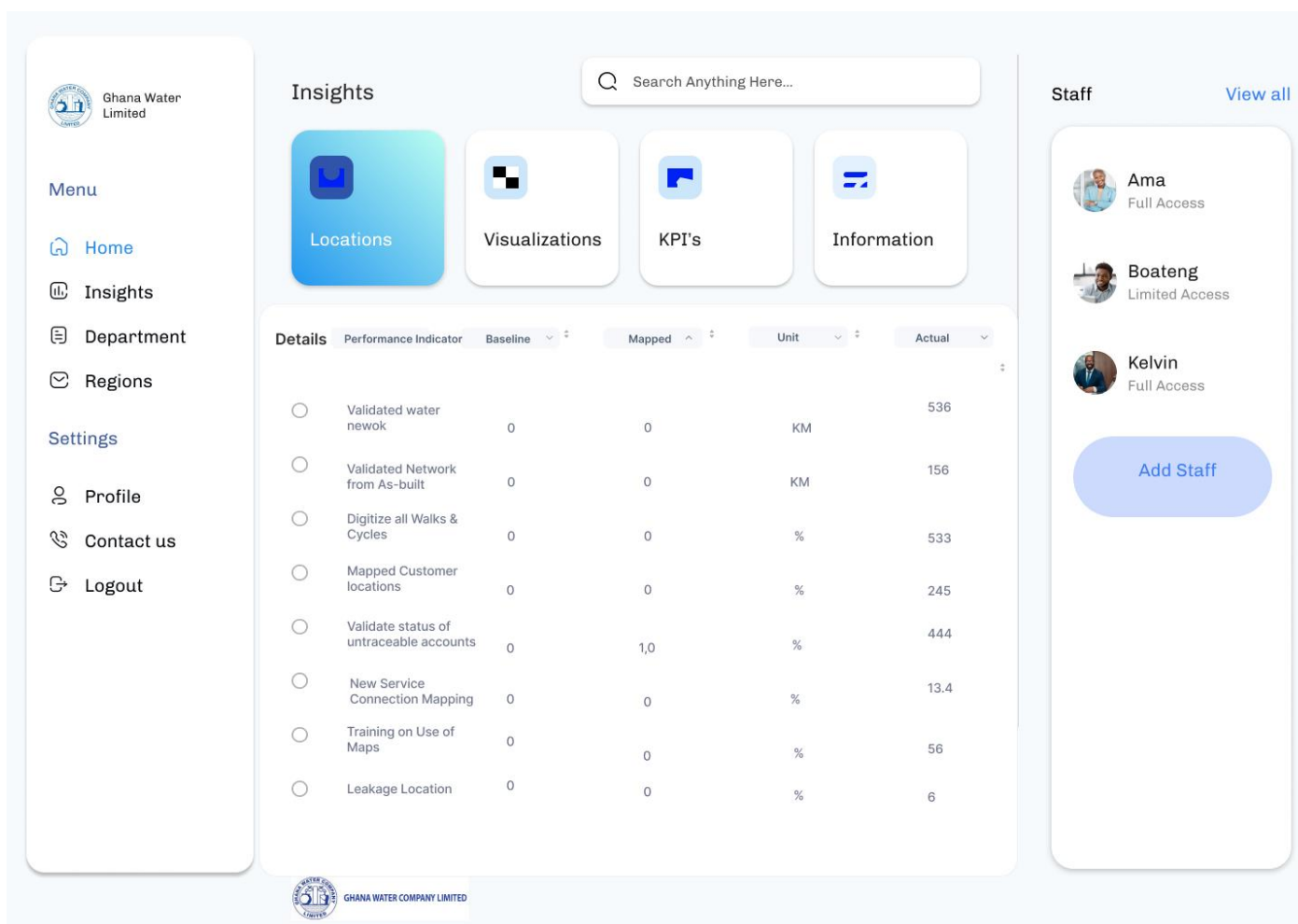


Figure 3.2 Reports and KPIs

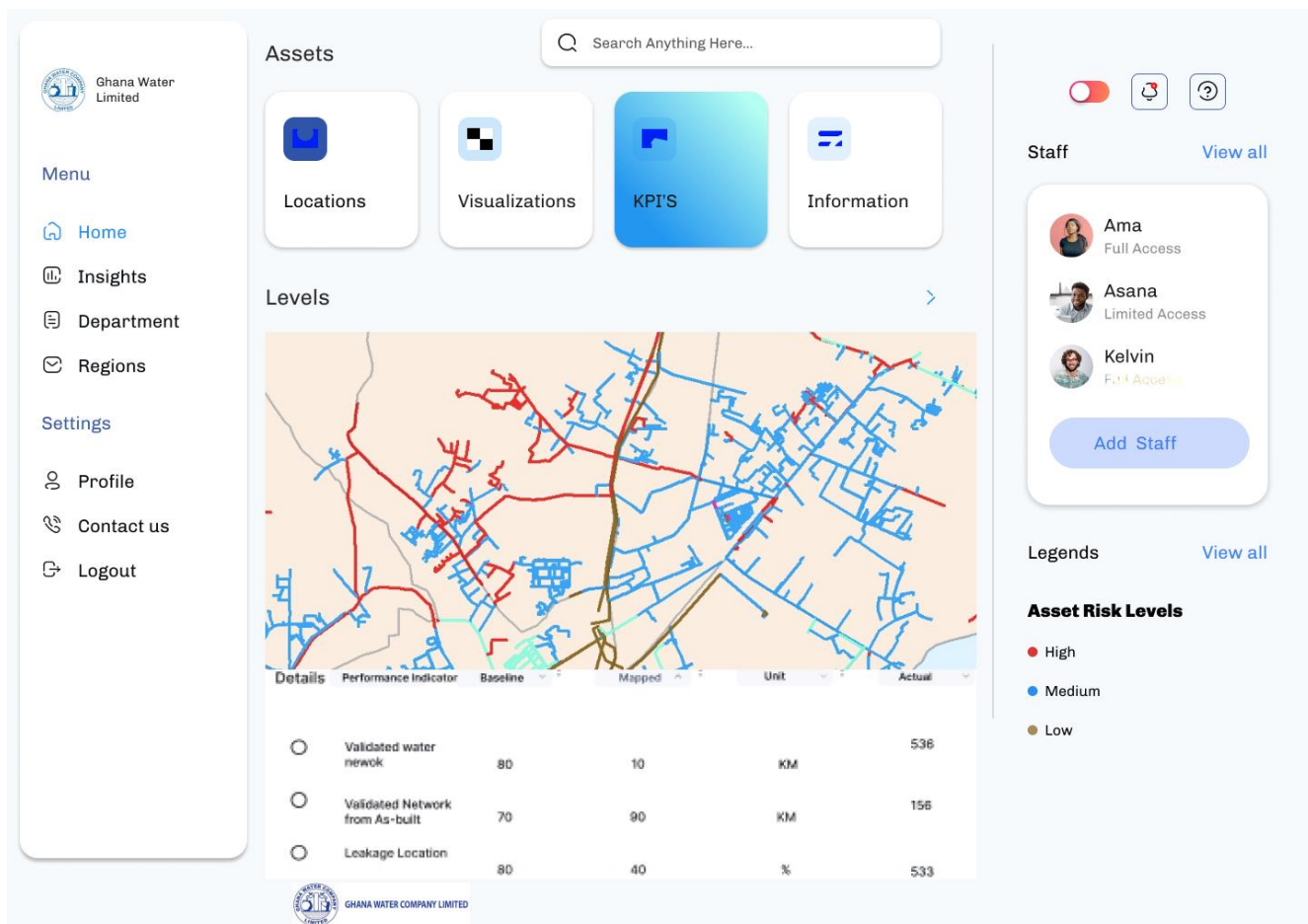


Figure 3.3 Asset Risk levels based on historical maintenance.

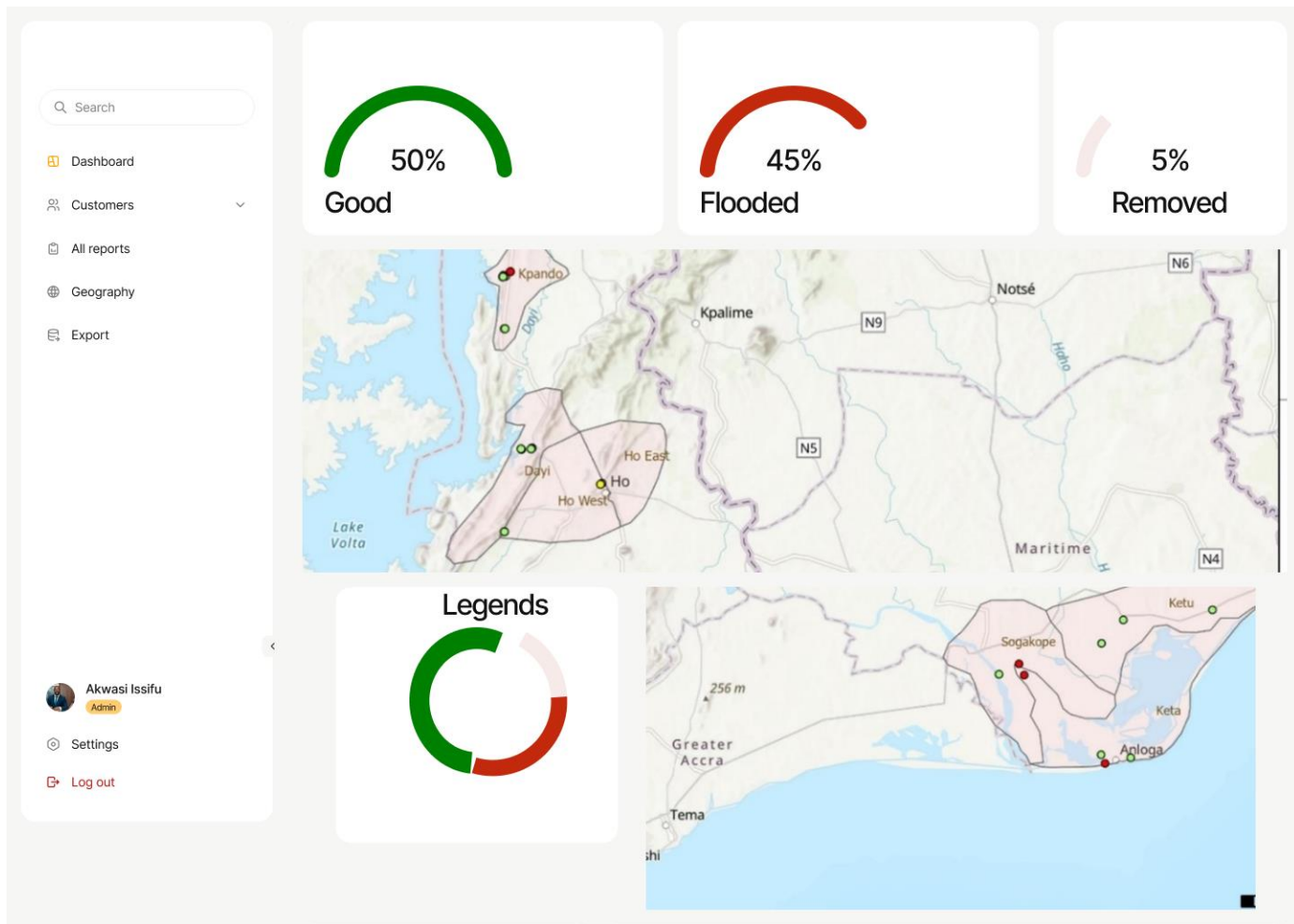


Figure 3.4 Status of bulk water meters in Volta Region

4. CONCLUSIONS

The study on the improving Monitoring of performances using spatial data by GWL has demonstrated the potential of improving insights gleaned from data to improve performance which was not considered beforehand. The strengths of spatial data in answering the 4W questions of (What, Where, When, and by Whom) effectively has improved the values of data

coming from all sectors within the company. The proposed system provides very valuable insights to the M&E team to drill deep into operational gaps to improve the efficiencies of the utility.

Even though challenges of data quality cannot be ruled out, the benefits of the Geospatial based M&E seek to fish out those irregularities when utilized properly and efficiently.

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BIOGRAPHICAL NOTES

GS. Ing. Surv. Michael Nyoagbe is a Geospatialist and a Manager at the Ghana Water Limited (GWL) at the Technology and Innovation Department where he works as the Head of Research and Innovation Unit. Michael has over 16 years experience in the Geospatial and Survey industry. He has a career in GIS Consultancies internationally and locally with special interest in application development and artificial intelligence. His research interest focuses on Artificial Intelligence and GIS amongst many other areas. He is the President of the Ghana Geospatial Society (GGS), a member of Ghana Institution of Engineering (GhIE), Licensed Surveyors Association of Ghana (LiSAG), Ghana Institution of Surveyors (GhIS), and the International Federation of Surveyors (FIG).

Ing. Mawunyo Kofiloto is the Officer in Monitoring and Evaluation under Corporate Planning, Monitoring & Evaluation Department in Ghana Water Limited. Ing. Mawunyo has been involved in various international and national consultancies on Water Management and Water Loss. He has published many peer-reviewed papers in international journals. He is a Member of Ghana Institution of Engineering (GhIE).

GS. Surv. David N.O Nunoo is a professional with over 14 years of experience in Geographic Information Systems (GIS). He holds a Bachelor of Science degree in Geomatic Engineering and a Master of Philosophy in Geospatial Information System. David possesses a strong academic foundation coupled with extensive practical expertise. He heads the GIS and Hydraulic Network Modelling unit at Ghana Water Limited (GWL). His proficiency in using GIS software and geospatial tools was instrumental in setting up the GIS unit and facilitating informed decision-making based in GIS to drive operational efficiencies for the company. His work spans various disciplines including utilities, urban planning, and engineering surveys. He is a Professional Member of the Ghana Geospatial Society(GGS) and Ghana Institution of Surveyors (GhIS).

Ing. GS. Surv. Rosaline Arthur holds a bachelor's degree in Geomatic Engineering. She is a professional with almost 10 years of working experience. Rosaline started as an Assistant Geomatic Engineer at TDC Development Company Limited, Tema where she primarily prepared site plans for clients interested in acquiring lands within the Tema township. She was appointed as team lead to set up the GIS Unit having expressed interest in GIS right from KNUST. Soon after, she grabbed the opportunity to work as a Survey Engineer with Eiffage Genie Civil, a French Company, on the Tema Port Expansion Project (TPEP). Rosaline is a currently a Geospatialist and a Regional GIS Officer at Ghana Water Limited, Central Region (CR). She has been actively involved in capturing, analyzing and managing spatial and attribute data of GWL assets and in various national consultancies in GIS applications and software. In addition, she conducts periodic training for both the distribution and commercial staff of the company in the region. She is a Professional Member of the Ghana Institution of Engineering (GhIE), Ghana Geospatial Society (GGS) and Ghana Institution of Surveyors (GhIS).

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