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NEWSLETTER

NINTH EDITION | OCTOBER 2024

THE PREMIUM GEOSPATIAL BULLETIN

FOREWORD

Welcome to the Ninth Edition of the Sambus Geospatial Newsletter! This edition marks a significant moment in our journey as we continue to make strides in the geospatial industry across West Africa.

In this issue, we reflect on the monumental success of the inaugural Esri User Conference West Africa, a groundbreaking event that brought together industry professionals, experts, and decision-makers to drive innovation and collaboration in the geospatial sector.

Additionally, we showcase some of the latest cutting-edge geospatial products such as the Trimble TDC 6, Wingtra Gen II drone, ArcGIS Pro, and ENVI DEM Extraction module—all tailored to support the diverse needs of our users.

We are also pleased to bring you insightful articles that highlight impactful geospatial projects from around the globe, including assessing food insecurity in vulnerable countries and the modernization of land administration in Angola using GIS technologies.

Don't miss our Events Gallery featuring highlights from the Esri User Conference West Africa and the FIG Working Week, as well as our Maps and Projects page, where we continue to showcase the power of GIS in action.

As we move forward, we remain committed to supporting our clients and partners with innovative solutions to address real-world challenges. We hope this edition inspires and informs you of the possibilities that geospatial technology holds.

Enjoy the read!

Akua Aboabea Aboah



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ABOUT SAMBUS GEOSPATIAL

enhanced decision making in West Africa.

Core Values

Trust (T): Every business transaction is implicitly a relationship of trust as parties to any transaction have the assurance that they will receive value from the engagement. Trust is the starting point for Sambus with confidence in our staff to deliver value to our stakeholders as we trust that our stakeholders will do the same.

Service (S): Sambus does not just sell, we serve. We serve our clients and stakeholders and support them in reaching their objectives. There is an intrinsic reward in being of service to another, and we live by that at Sambus. We want all our stakeholders, from staff to business partners and clients to remain loyal to the Sambus brand, and it is through quality service that we achieve that.

Integrity (I): Integrity and honesty go side by side, and as a company that embraces openness, we uphold integrity and being morally upright in all our operations and business transactions.

Respect (R): Organizations are made of people, and every person is unique and special regardless of their rank and status in life. Respect for people is an integral part of the Sambus culture and it is our hope that this is reciprocated by all our stakeholders.

Honesty (H): Honesty and transparency in dealings and transactions are what we stand by and expect from all stakeholders.

Commitment (C): An unwavering commitment to delivering added value to our stakeholders and being innovative about the provision of solutions to clients. All our stakeholders are expected to reciprocate the same commitment offered to them.

ABOUT SAMBUS GEOSPATIAL

Sambus Geospatial is a technology integration firm that provides a range of geospatial solutions to different industries. With over 33 years of operational experience, our corporate alliance with geospatial giants; Esri, Trimble, NV5 Geospatial, and Wingtra Drones, has given us the edge in the implementation of location intelligence solutions to support and empower seamless workflow and informed decision making in every organization.

Sambus Geospatial operates in Ghana, Nigeria, Liberia, Gambia, Gabon, with operational offices in Ghana and Nigeria. We are also supported by resellers and partners across our operational regions. Operating with a compelling urge to empower the needs of Africa using State-of-the art geographical standard technology, Sambus Geospatial remains the most preferred mapping and geospatial solution provider in West Africa. The organization has qualified staff who develop and deploy tailor-made solutions for all our clients to gain optimum benefit and satisfaction.

Vision statement

To be the preferred geospatial innovator in West Africa.

Mission statement

To become a distinguished organization in the application and advancement of geospatial knowledge and technology for effective planning, operations and

WATCH THE RECORDED SESSION OF THE

Esri User Conference West Africa 2024

Watch the recordings and the presentations at the just ended Esri User Conference held in Abuja , Nigeria. Be inspired about mapping the future together with us.

Click on the link to watch the recording:

<https://bit.ly/4fThxVf>



Esri User Conference West Africa: A Milestone Event for Geospatial Innovation and Collaboration



The inaugural Esri User Conference West Africa, organized by Sibus Geospatial Limited, marked a significant milestone in fostering collaboration, knowledge sharing, and innovation across the geospatial industry in West Africa. Held at the NAF Conference Center in Abuja, Nigeria, from September 10-11, 2024, the conference gathered over 506 registered participants, with 253 attending in person and 107 devices joining virtually. The event was designed to facilitate networking opportunities, highlight successful geospatial projects, and empower users with cutting-edge solutions.

Themed “Geospatial Synergy: Mapping the Future Together,” the two-day event featured thought-provoking keynote speeches from Princess Zahra Mustapha Audu (Technical Adviser to the President of Nigeria on Foreign Direct Investment), Karim Assem (Esri Senior Business Development Manager, West Africa) and Bashir A. Adeniyi MFR DSM FNIPR PSC(+) (Comptroller General of Customs Service, Federal Republic of Nigeria) on the conference theme. The conference was also graced with the presence of Surv. Abuduganiyu Adebomehin (Surveyor General of the Federal Republic of Nigeria) as a guest speaker. Esri representatives and key stakeholders from across the region also shared invaluable insights during interactive panel discussions, and technical demonstrations showcasing the impact of geospatial technology on industries



such as oil and gas, mining, agriculture, and urban development. The conference brought together professionals and industry leaders from Ghana, Sierra Leone, Liberia, and Nigeria to share insights, experiences, and best practices.

Key highlights included:

- Customer success stories from Eko Electricity Distribution Company - Nigeria, National Minerals Agency - Sierra Leone, and Okomu Oil Palm Company Plc - Nigeria, among others.
- Innovation showcase from National Population Commission (NPC), Milsat, and Jamitan Tech highlighting emerging technologies and startups in the Geospatial Sector.
- Panel discussions on emerging geospatial trends and enhancing collaboration and partnerships, as well as, networking sessions.



These presentations and sessions underscored how organizations across the region are leveraging Esri’s ArcGIS platform to drive innovation, streamline operations, and enhance decision-making processes.

Sibus Geospatial remains committed to advancing the adoption of geospatial technology across West Africa. This event was a testament to the growing community of professionals using geospatial solutions to transform their industries, improve outcomes, and create a more sustainable future.

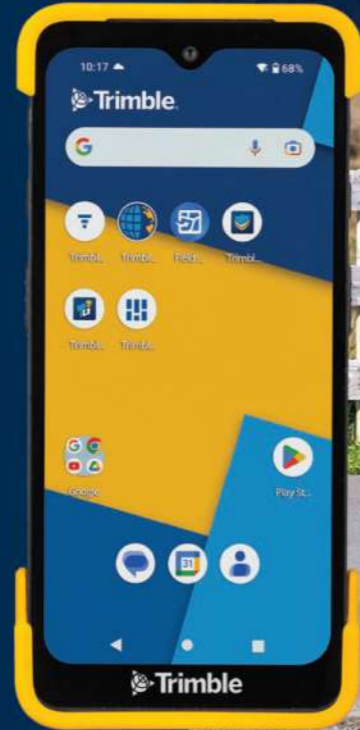
We extend our heartfelt appreciation to all our participants, speakers, and partners for making the Esri User Conference West Africa a resounding success. We look forward to continued collaboration and working together to map the future of West Africa’s geospatial landscape.



Trimble TDC6

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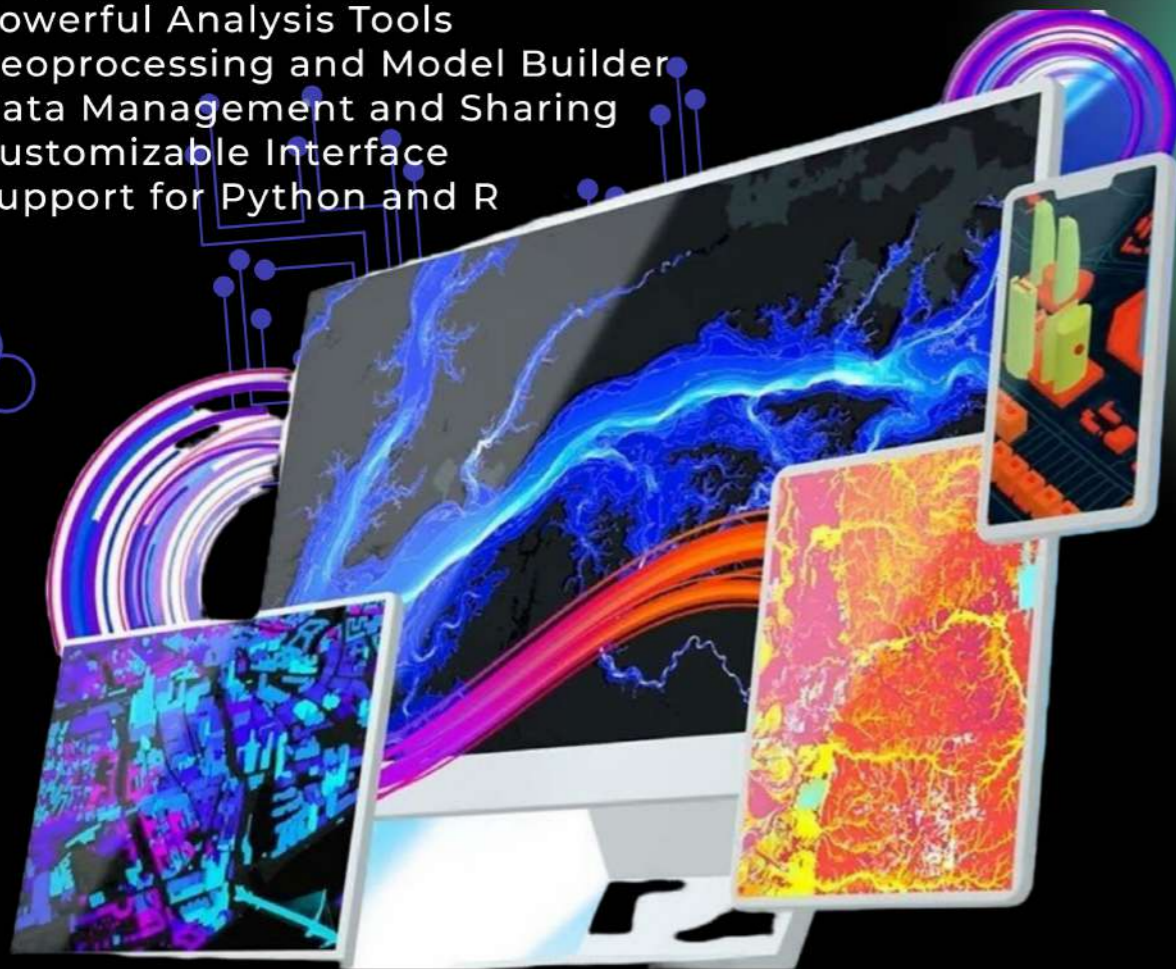
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- Data Management and Sharing
- Customizable Interface
- Support for Python and R



Get Started with the Future of GIS: Sign Up for ArcGIS Pro and Innovate Today!



ENVI DEM Extraction Modules

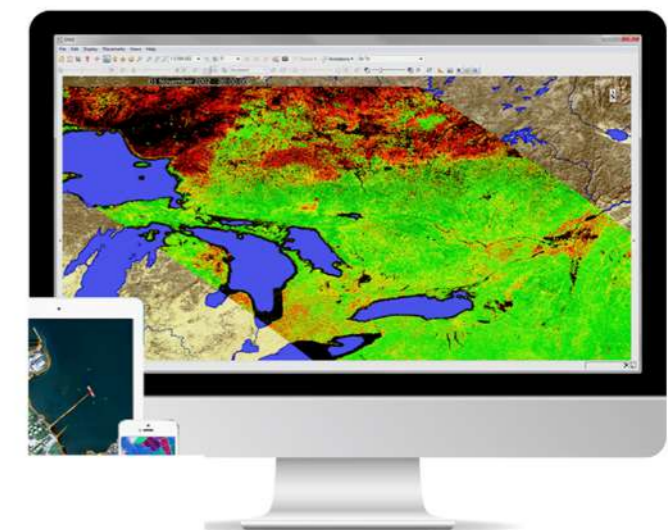
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With the module's interactive workflow, you can produce accurate and robust models from virtually any airborne or satellite stereo pair images with RPCs.

The module includes flexible viewing, measurement and editing tools to enhance your 3D representations.

Elevate your geospatial projects today!

ENVIS GEOSPATIAL

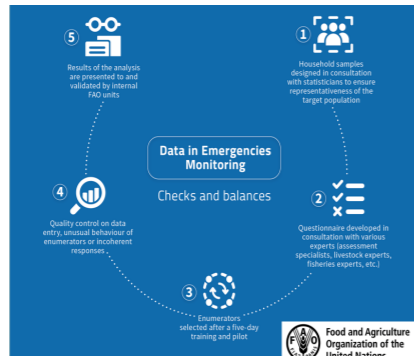


Assessing the Needs of the World's Most Food Insecure Countries

In 2022, it was the onset of the ongoing conflict in Ukraine. In 2023, it was extreme heat across many countries and fall armyworms munching maize crops across southern Africa. These leading causes of food insecurity are just a few of the crises in focus for the Food and Agriculture Organization of the United Nations (FAO). The Data in Emergencies (DIEM) team uses satellite imagery, data collected from the field, and advanced spatial analysis and mapping to investigate root causes and mitigation strategies to reduce food insecurity.

People are living in situations where they are constantly being hit by something, said Neil Marsland, head of the DIEM team in the Office of Emergencies and Resilience at FAO in Rome. You can have a flood followed by a livestock disease outbreak and, at the same time, have conflict breaking out and the currency plunging. FAO kicked off a data-driven monitoring program in 2020 during the pandemic to assess rising agricultural stresses in countries where food insecurity has become chronic. To monitor food vulnerability and survey the needs of farmers, the team created the DIEM Hub using geographic information system (GIS) technology and remote sensing.

Food scarcity has historically been connected to government instability. Ac-



According to the World Food Programme, more than 80 percent of UN mobilized resources have gone to conflict areas in recent years. The most war-torn countries face perpetual cycles of hunger and instability.

Famines are pretty rare, thankfully, but we do have many situations where people are rapidly depleting their assets in order to get access to food, Marsland said. They are engaging in what we call negative coping strategies, such as selling off their last productive animal or migrating away from the household in a desperate attempt to find work.

Analysts at the Food and Agriculture Organization of the United Nations (FAO) use GIS, remote sensing, and survey data to evaluate food security and agricultural production with the aim of making countries prone to multiple shocks more resilient to disruptions. (Editors note: The views expressed in this publication are those of the author and do not necessarily reflect the views or policies of the Food and Agriculture Organization of the United Nations.)

Key Takeaways

FAO analysts gather data to analyze drivers of food insecurity in countries that experience ongoing food crises.

Enumerators conduct surveys with agricultural and non-agricultural households

to understand the state of income and shocks, crops, livestock, food security, and needs.

The Data in Emergencies (DIEM) Hub provides open access to all data collected, and in-depth reports.

Working Where the Need Is Greatest Marsland and the DIEM team monitor 27 countries facing food crises and analyze the connections among climate change, conflict, migration, geopolitics, and economics. Analysts on the team use satellite imagery and GIS technology to create models that can detect livestock hardship and crop stress. Inputs from a network of in-country enumerators add perspective on agricultural production and the impact of storms or pests, helping the team determine what producers may need. When it's too dangerous to go door-to-door, assessments are completed via computer-assisted telephone interviews.

They are telling us they need food, but also other things, Marsland said. They need seed to plant the next crop and vaccinations to keep their animals from dying. With GIS, we are able to map and display this data very clearly. We can compare needs within a country, across time, and look at the needs of all countries.

The DIEM Hub analyzes, maps, and stores the 150 indicators collected during each survey in countries such as Afghanistan, Lebanon, Yemen, Burkina Faso, Mali, Sudan, and Colombia. The surveys of approximately 150,000 households each year performed every two to six months provide an accurate picture of food production trends and volatilities.

Since the DIEM Information System was launched, the team has extended

its network of partners, including national government agencies in the countries it monitors.

Prior to 2020, the UN did not receive regular updates on how and where food insecure regions were impacted by crises. Now, through DIEMs DIEM-Impact, analysts can provide initial impact assessments within 72 hours of a shock or hazard. This has been helpful in understanding events such as the flooding in Libya, the destruction of the Kakhovka dam in Ukraine, tropical cyclone Mocha in Myanmar, and the fall armyworm infestation in Burkina Faso. These reports, often built with ArcGIS StoryMaps, present compelling and actionable details.

Survey apps on mobile phones help streamline data collection. Automation and cloud computing enable rapid data processing. Digital workflows validate data and speed government approvals. And the DIEM Hub, an open data site, shares information and stories instantly.

Analyzing Cascading Impacts of Conflict The DIEM Information System has evolved over the few years it has been operating. Analysis conducted in the Sahel region of West Africa helped transform the teams mission when they were able to provide accurate data and quantify the complex factors leading to food insecurity across the region extending beyond monitoring to show causes and effects.

We've been able to analyze ongoing conflict in the Sahel and the impact of seasonal flooding that has become more frequent and severe with climate change, Marsland said. We provide a really good set of tools to analyze the impacts affecting marginalized individuals and communities that depend on growing crops and taking care of livestock.



Reports include analysis of satellite images, including radar images to see through clouds, and all the local knowledge the team collects about agricultural conditions and impacts.

When Ukraine's Kakhovka dam was breached, for instance, the immediate concern was that the nearby farms would be flooded. But then analysts began to look more closely at the effects of the emptying reservoir.

We realized the main problem was the irrigation channels, said Andrea Amparore, data manager for DIEM. There are three irrigation systems among the biggest in the world that were fed by the reservoir. The loss of water will have a huge impact on agricultural production in Ukraine and Russian-occupied territories until the dam can be rebuilt.

Knowing the food-related impacts on people helps the network of providers prioritize relief work and devise longer-term strategies such as determining how to fill the gap in grain caused by the ongoing conflict in Ukraine.

Expanding the Reach Analysts at Cornell University and local universities such as Marondera University in Zimbabwe also use the data stored in the DIEM Hub to examine root causes of food insecurity and to come up with strategies to mitigate hunger.

Professors and their students investigate possible connections between shocks and food insecurities, Amparore said. They explore the factors that can increase or decrease the resilience of certain households compared

to others.

To further extend analytical capabilities, the DIEM team is investigating how artificial-intelligence-based machine learning can process imagery and further automate answers to questions.

While only a few years old, DIEM has gained momentum and a growing appreciation from the community of food providers it serves. The work recently appeared in the world's leading multi-disciplinary science journal Nature. The team has visits planned to the various DIEM regions to build awareness of the available data and encourage local investment in the initiative.

In its ongoing work, DIEM will continue to build awareness of the tool to support sustainable and sustained food monitoring. The ultimate goal is to foster stability in the countries prone to multiple shocks.

What we hear in the headlines is people being given emergency food, which is clearly a critical intervention, Marsland said. What we are trying to understand in more detail is what other needs these households have to support their livelihoods and their families and as importantly, what to do about it.



By - Olivier Cottray
Director of Humanitarian Solutions at Esri

Angola Modernizes Land Administration with GIS and Cadastre Management

Millions of people move to cities to seek better livelihoods, education, and health to improve their quality of life. This rapid population growth within cities is posing challenges for governments worldwide. The African nation of Angola, for example, has an urbanization rate of 68 percent. The capital city, Luanda, has experienced population growth of 3.8 percent from 2022 to 2023. Struggling to keep up with this growth, the country's real estate sector is facing issues such as illegal land occupations and informal, unregulated land transactions. Many buildings are constructed without proper registration or documentation of property and land ownership. Most of the citizens in urban areas lack official ownership documentation and security of tenure. The high demand and tenancy turnover have also created problems for public institutions that must collect the appropriate fees and taxes for property sales. This has led to a lack of necessary revenue for basic infrastructure such as water, electricity, roads, and education for municipalities.

Land management in Angola is also complex and involves many stakeholders and entities. The country's two main land management entities are the property registry offices Conservatória do Registo Predial (CRP) under the Ministry of Justice (MINJUS) and the national mapping and cadastre agency, Instituto Geodésico e Cartografia de Angola (IGCA). IGCA works under the Ministry of Planning, Urbanism, and Construction (MINOPUH), which is responsible for mapping Angola's terrain and infrastructure and for managing the national cadastre—a comprehensive land registry that records property boundaries, land values, and land concessions details.

Understanding the lack of sufficient accurate legal documentation of ownership and parcel boundaries, and with an ambitious goal to provide affordable housing and improve the real estate market and land-based taxes, Angola's government contacted the Mitrelli Group. The Mitrelli Group is an international group of companies that promotes and executes sustainable large-scale social and economic growth projects in the developing world, with two decades of proven experience in Africa.

Angola worked with Mitrelli Group subsidiary and Esri partner GEODATA, which specializes in advanced land management GIS and mapping solutions for national entities, and implemented a solution to modernize and streamline the

country's land administration process.

Helping Make Growth Possible with GIS

One specific focus of Angola's government has been to improve land cadastre accuracy and consistency. Cadastre plays a critical role in preventing land disputes and provides essential details such as ownership, boundaries, and the value of real property in a given area.

The Angolan government faced the challenge of mapping hundreds of thousands of parcels in a cost-effective way in just a few years and registering properties on a massive scale.

To address these challenges, GEODATA purchased a software agreement with Esri to implement the Land Administration Modernization Program (LAMP). LAMP provides access to ArcGIS software for developing countries to enable land agencies to undertake needed modernization initiatives. Utilizing the LAMP program, GEODATA was able to develop a distributed cadastre system with ArcGIS Pro professional workflows coupled with ArcGIS Enterprise for distributing, viewing, querying, and managing by authorized stakeholders. GEODATA leveraged drone-acquired imagery with photogrammetric mapping techniques using ArcGIS Drone2Map and geospatial AI (GeoAI) to automate feature extraction and analysis. By creating centimeter-level accurate orthophotographs and 3D mapping, GEODATA helped IGCA save time and dramatically improve data accuracy. Address surveys using the mobile app ArcGIS Collector were also conducted to create



a more accurate and updated address database including street names with all historical name versions and house numbers.

The imagery, 3D mapping, and address database combined with existing historical data, maps, and other documentation, were used by GEODATA professionals to create 450,000 accurate urban parcel boundaries. These were implemented into the cadastre system and the entire process was completed within less than three years.

GEODATA also developed a system for the registration process at the CRP offices to support and automate the legal mass registration of 100,000 properties as part of an affordable housing project managed by the state.

GEODATA implemented the registration system in all 22 registry offices in all 18 provinces of Angola. The new cadastre system was distributed throughout all 18 province offices of IGCA with comprehensive training, technical support, and knowledge transfer. The two systems are connected via a bidirectional interface which enables the registry office to view related properties on a map.

Implementation of a geospatial-based cadastre system and the integration with the land registry achieved several objectives, including the following:

Increased security and legal certainty for registrants regarding ownership of the property as well as fostering public land tenure

Accurate boundaries of the property parcels

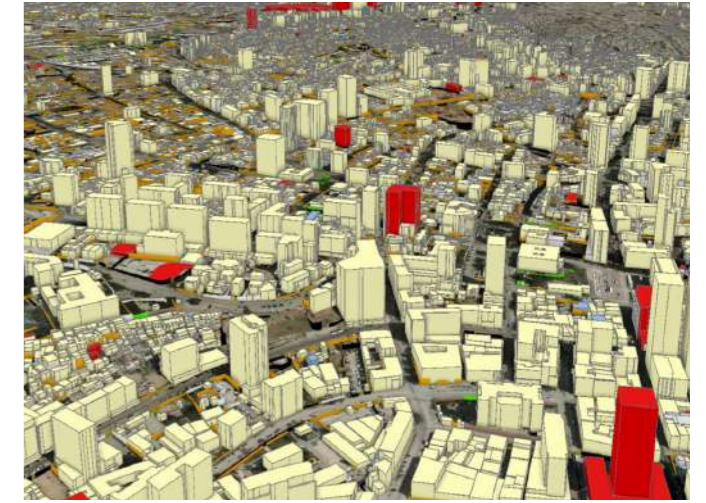
Reliable property information used to improve land management and collection of taxes

Improved land information to support urban planning

A screenshot of an ArcGIS Pro window with a parcel map surrounded by menus and toolbars

Enabling Future Growth

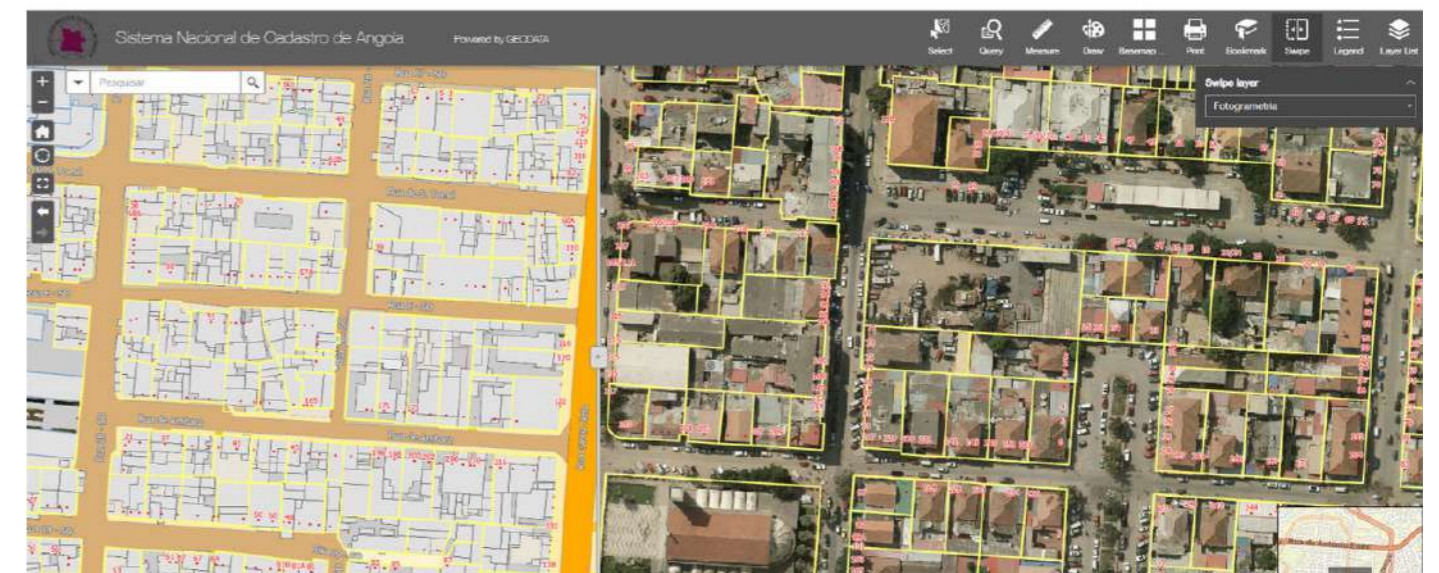
With a multitude of agencies involved in land management, the government of Angola has an ambitious goal to provide affordable housing to millions of people and increase the number of registrations to more than a million properties



by 2027. The Esri LAMP program has provided critical technology in helping to realize that goal. The new interconnectivity of the cadastre system with the registration system now enables the generation of a deed or legal document and displays an accurate map of the property. Since Angola's General Tax Administration will interface with this system regularly, property-related taxes and fees for the government are expected to increase significantly.

As the national economy grows throughout the country and the number of individuals looking for housing increases, the Angolan government expects to see a marked expansion of new home construction. Having accurate boundaries of parcels of land with efficient digital land registration processes will assist the government in its goal of one million new homes built on those vacant parcels with appropriate right-of-use and ownership.

A screenshot of a GIS computer program window with a map and imagery outlining parcel boundaries and a gray toolbar at the top





FEATURE IN OUR NEXT NEWSLETTER

Send your projects and articles to
events@sambusgeospatial.com

**TRIMBLE DIMENSION
USER CONFERENCE 2024**
11 - 13 NOVEMBER

GEO TUNIS 2024
18 - 22 NOVEMBER

BIG 5 GLOBAL SUMMIT
26 - 29 NOVEMBER





Events Gallery





Maps and Projects

OFF-GRID COMMUNITY ENGAGEMENT USING GEOSPATIAL TECHNOLOGY, WAMBA, NASARAWA



INTRODUCTION

Access to reliable and affordable electricity is a fundamental need, yet many communities in remote areas of Nigeria continue to grapple with limited or no access to the power grid. The purpose of this community engagement report was to introduce a sustainable energy option to an off-grid community in Nasarawa State (Wamba Community), Nigeria. The visit aimed to assess the community's energy needs, educate residents about the benefits of off-grid Power, and foster community participation and support for its implementation. This localized power generation and distribution system can be tailored to suit the unique requirements of each community, offering a viable alternative to traditional centralized grid infrastructure. Our goal with this community engagement report is to present a compelling case for the adoption of a mini-grid system as a catalyst for positive change in this off-grid community of Nasarawa State. By providing reliable and clean electricity, we believe that the mini-grid system can empower individuals, stimulate economic growth, improve social services, and enhance overall community well-being.

During our visit, we engaged with community members, local leaders, and stakeholders to understand their energy challenges and aspirations. We conducted assessments of the community's energy needs, evaluated the feasibility of a minigrid system, and explored potential collaborations with relevant organizations and government agencies. The introduction of a minigrid system holds tremendous promise for the Wamba communities in Nasarawa State. Access to electricity will have a transformative impact on various aspects of community life. It will enable children to study after sunset, enhancing educational opportunities and improving academic outcomes. It will empower healthcare facilities with reliable power, supporting critical medical services and improving overall healthcare delivery. Additionally, it will catalyze economic growth, opening doors for new businesses, creating jobs, and improving livelihoods.

In this report, we will present a comprehensive analysis of our visit, including community assessments, feasibility studies, and engagement strategies. We will also outline the potential benefits and challenges associated with implementing a minigrid system, as well as the proposed roadmap for its successful deployment in the community.

We firmly believe that sustainable energy solutions, such as minigrid systems, can drive positive change and uplift communities thereby serving as a resource for our stakeholders and policymakers in our organization for sustainable energy and community development in the site. We hope that the insights and recommendations outlined in this report inspire further dialogue, collaboration, and support from stakeholders, policymakers, and development organizations. Together, we can pave the way for a sustainable and inclusive future, where every community has access to reliable electricity and the opportunities it brings.

1.1 BACKGROUND

Wamba community is positioned in the western region of Nasarawa State, which is situated centrally within Nigeria. It is located near the border with Plateau State, encompassed by a rural landscape characterized by gentle hills, agricultural fields, and natural vegetation. Situated approximately 240 kilometers (150 miles) to the north of Nigeria's capital city, Abuja, Wamba enjoys its own distinct geographic location within Nasarawa State. Wamba community, situated in Nasarawa State, is a remote and off-grid region with limited access to electricity. The absence of a reliable power supply significantly hampers the community's progress in various aspects of life. Residents face challenges in lighting their homes, powering essential appliances, and running businesses efficiently. Lack of electricity also affects education, healthcare, and overall quality of life, limiting opportunities for growth and development. Recognizing the urgent need for sustainable solutions to the energy deficit, the introduction of a mini-grid system emerges as a viable option for Wamba community. Unlike traditional grid systems that rely on centralized power sources, a mini-grid system utilizes renewable energy resources such as solar, wind, or hydro power to generate electricity locally. This decentralized approach can provide a reliable and sustainable energy solution tailored to the specific needs of the community.

In terms of infrastructure, Wamba has been devoid of a connected power grid system that can provide consistent and sufficient electricity supply. Despite these challenges, the community of Wamba has persevered, demonstrating resilience and resourcefulness in finding alternative means to meet their energy needs. However, the introduction of electricity through a mini-grid system offers a potential solution to address the long-standing energy deficit and unlock opportunities for socio-economic development, education, healthcare, and overall community well-being.

By acknowledging the history of the community's struggle with electricity access, it becomes even more imperative to prioritize efforts to introduce sustainable energy solutions such as a mini-grid system. Such initiatives can empower the community, improve their quality of life, and contribute to the overall progress and development of Wamba in Nasarawa State. The absence of electricity has also impeded the community's economic growth and livelihood opportunities. Local businesses have faced significant challenges in operating efficiently and expanding their activities. The lack of power for machinery, refrigeration, and other essential equipment has limited productivity and constrained the development of entrepreneurship and income-generating activities.

2. COMMUNITY ENGAGEMENT

During our engagement with the communities, we were able to establish trust and build relationships with the members of the Wamba community. This will involve engaging with community leaders, local organizations, and individuals to understand their perspectives, concerns, and aspirations related to access to electricity. With our engagements, we were able to Assess Energy Needs and Challenges, Identify Community Priorities and Aspirations and raise Awareness and Provide Information

2.1 METHODOLOGY

Community Meetings: Organize community meetings to gather input, share information, and foster open dialogue with community members.

a) Surveys and Interviews: Conduct surveys and individual inter-

views to gather quantitative and qualitative data on energy needs, challenges, and aspirations.

b) Focus Group Discussions: Facilitate focus group discussions to encourage collective input, insights, and ideas from community members.

c) Stakeholder Consultations: Engage with relevant stakeholders, including community leaders, local authorities, and organizations working in the energy sector, to seek their perspectives and potential collaboration opportunities.

d) Information Sharing Sessions: Conduct informative sessions to share knowledge on off-grid electricity solutions, their benefits, and potential implementation strategies.

e) Continuous Feedback Mechanism: Establish a feedback mechanism to ensure ongoing communication with the community, enabling them to provide input, ask questions, and address concerns throughout the project duration.

We were also able to discuss with the stakeholders the potential benefits of Mini-Grid Electricity in their communities. Some of those benefits are listed below:

a. Socio-economic Development: Access to electricity is a catalyst for socio-economic growth. With reliable power, Wamba community can support local businesses, stimulate economic activities, and create employment opportunities. The availability of electricity will enhance productivity, encourage entrepreneurship, and attract investment, contributing to the overall development of the community.

b. Education and Skill Development: Lack of electricity adversely affects education in Wamba. Schools struggle to provide adequate lighting, hindering study hours and access to educational resources. Introducing a mini-grid system will enable well-lit classrooms, power educational tools, and facilitate e-learning initiatives. Improved educational opportunities will empower the younger generation, leading to better prospects and a brighter future.

c. Healthcare Services: Access to electricity is crucial for reliable healthcare services. Without electricity, medical facilities in Wamba face significant challenges in storing vaccines, refrigerating medicines, and operating life-saving equipment. By introducing a mini-grid system, healthcare centers can provide better services, ensure proper storage of medicines, and enhance the overall quality of healthcare delivery, resulting in improved health outcomes for the community.

d. Community Well-being: Electricity plays a vital role in enhancing overall community well-being. It enables the use of modern appliances, such as refrigerators, fans, and communication devices, improving living conditions and connectivity. Additionally, well-lit streets and public spaces contribute to community safety, promoting a sense of security and fostering social cohesion.



3. DATA ANALYSIS

As part of the community engagement efforts for an off-grid site in Nasarawa State, a survey form was deployed using the ArcGIS Survey123 to collect valuable responses from community members. The purpose of the survey form was to gather insights, perspectives, and feedback to inform the project's design, implementation, and alignment with the community's aspirations and priorities. This section outlines the process of using the survey form and highlights its significance in facilitating community engagement. Once the survey responses were collected on the phone, the data were submitted, organized, and stored securely. Data cleaning processes (QA/QC) were conducted to ensure accuracy and consistency at the backend.

COMMUNITY NAME	LONGITUDE	LATITUDE	POPULATION	ENERGY NEEDS (KWH/MONTH)	PREFERRED ENERGY SOLUTION	CONTACT PERSON	CONTACT EMAIL	CONTACT PHONE
Community A	8.5123	9			Solar Power	John Doe	john@email.com	+234XXXXXXXX
Community B	8.7234	9			Biogas	Jane Smith	jane@email.com	+234XXXXXXXX
Community C	8.9345	9			Micro-hydro	James Johnson	james@email.com	+234XXXXXXXX
Community D	8.7421	9			Solar Power	Sarah Adams	sarah@email.com	+234XXXXXXXX
Community E	8.9034	9			Wind Power	David Brown	david@email.com	+234XXXXXXXX
Community F	8.1234	9			Solar Power	Lisa Johnson	lisa@email.com	+234XXXXXXXX
Community G	8.5678	9			Biogas	Michael Smith	michael@email.com	+234XXXXXXXX
Community H	8.8765	9			Micro-hydro	Emily Davis	emily@email.com	+234XXXXXXXX
Community I	8.789	9			Solar Power	Robert Johnson	robert@email.com	+234XXXXXXXX
Community J	8.9876	9			Wind Power	Jessica Thompson	jessica@email.com	+234XXXXXXXX
Community K	8.3456	9			Biogas	Andrew Robert	andrew@email.com	+234XXXXXXXX
Community L	8.4567	9			Micro-hydro	Olivia Davis	olivia@email.com	+234XXXXXXXX
Community M	8.6543	9			Solar Power	Ethan Smith	ethan@email.com	+234XXXXXXXX
Community N	8.8765	9			Wind Power	Ava Johnson	ava@email.com	+234XXXXXXXX
Community O	8.4321	9			Micro-hydro	Matthew Thompson	matthew@email.com	+234XXXXXXXX
Community P	8.6789	9			Solar Power	Sophia Wilson	sophia@email.com	+234XXXXXXXX
Community Q		9			Wind Power	Lily Thompson	lily@email.com	+234XXXXXXXX

4. RECOMMENDATIONS AND CONCLUSION

Based on our community engagement activities and assessments, the following key findings were gotten:

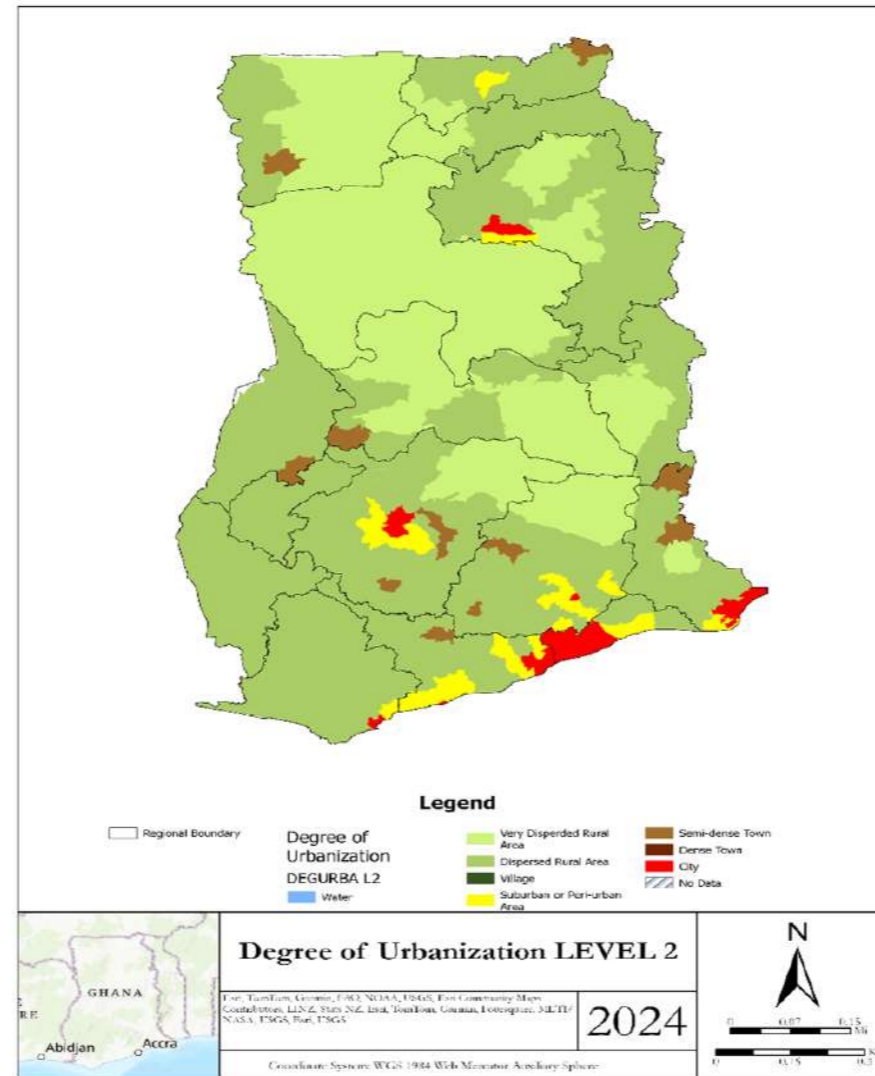
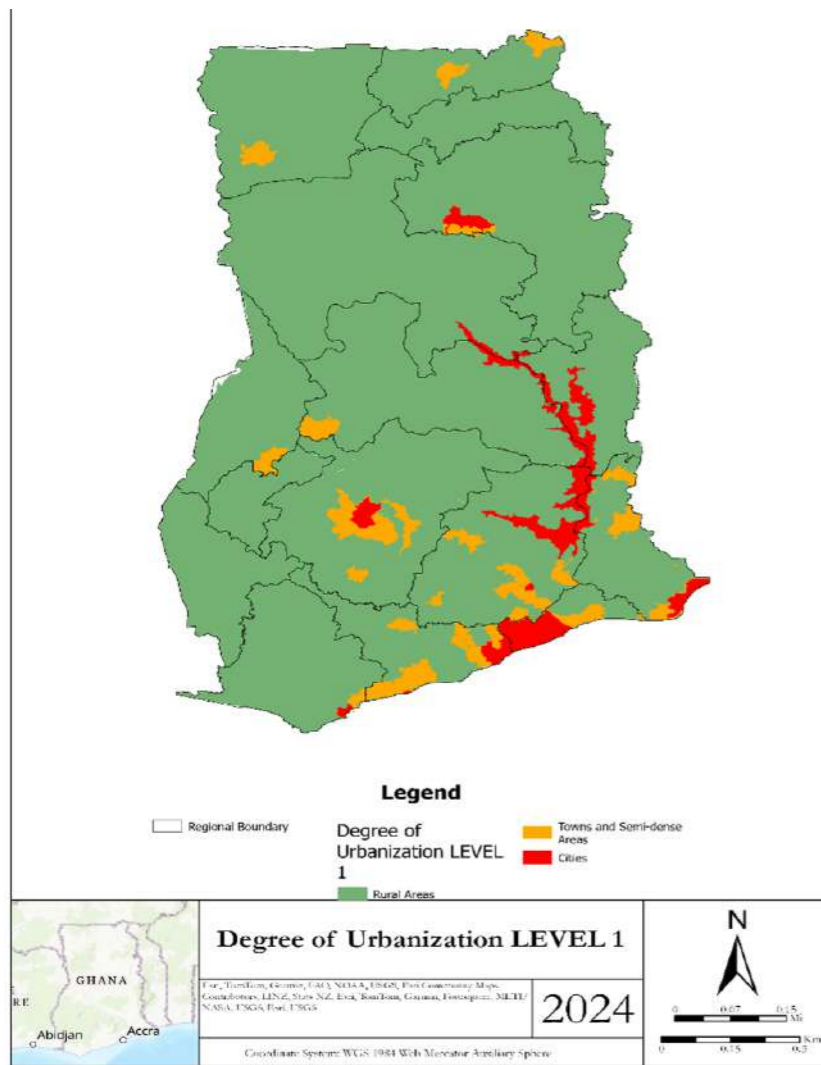
a. Energy Demand: The community expressed a strong desire for a reliable and affordable electricity solution to improve their daily lives, including household activities, education, and business opportunities.

b. Environmental Impact: Community members appreciated the environmental benefits of off-grid Power as it utilizes locally available agricultural waste (rice husks) and reduces dependence on fossil fuels/ solar panels.

c. Technical and Infrastructural Challenges: The community highlighted the need for infrastructure development, such as improved road access and storage facilities for rice husks, to support the implementation of off-grid Power.



Name: Ojumu Iyinoluwa Isaac
Location: Abuja, Nigeria



DEGURBA L2 Classification:

- City (22.7%):** Contiguous grid cells with a population density of at least 1,500 people per km² make up the city. There must be 50,000 people living in the city. This cluster's borders are smoothed and any gaps are filled. According to a study of Ghana's level of urbanization, the city has 6,984,044 residents.
- Dense Town (0%):** A dense urban cluster consists of contiguous cells with a density of at least 1,500 inhabitants per km², with a population of at least 5,000 and less than 50,000 in the cluster, and from the analysis, Ghana had 0 population density.
- Suburban or Peri-Urban Area (16.2%):** These cells are part of an urban cluster that is contiguous or within 2 km of a dense urban cluster or an urban center. According to a study of Ghana's level of urbanization, the suburban or peri-urban has a 4,998,122-population density.
- Semi-Dense Town (7.4%):** consists of contiguous grid cells with a density of at least 300 inhabitants per km² and has a population of at least 5,000. This cluster is neither contiguous with nor within 2 km of a dense urban cluster or an urban center. The semi-dense town has a total population of 2,271,817 according to the degree of urbanization in Ghana.
- Village (0%):** The village consists of contiguous cells with a density of at least 300 inhabitants per km² and a population between 500 and 5,000 in the cluster. Similarly to Dense Town, no areas were classified as Villages in this analysis.
- Dispersed Rural Area (46.4%):** are rural grid cells with a density of at least 50 and are not part of a village cluster. The dispersed rural area, according to the Ghana degree of urbanization has a population of 14,313,823.
- Mostly Uninhabited Area (7.3%):** are cells with a density of less than 50 inhabitants per km² and the mostly uninhabited area has a population of 2,264,213 according to the degree of urbanization in Ghana.

THE DEGREE OF URBANIZATION IN GHANA USING ARCGIS PRO

Introduction

In 2020, the degree of urbanization method to classify urban and rural areas around the world was endorsed by the United Nations (UN). Urbanization typically provides greater access to amenities and opportunities, while creating challenges such as increased air pollution and crime. Urbanization is a phenomenon reshaping the landscape of nations globally, and Ghana is no exception. Urban areas have been growing due to industrialization and the introduction of technology, while population dynamics in rural areas have been changing. By using Geographic Information Systems (GIS) tools such as ArcGIS Pro, we can analyze these spatial patterns in more detail and determine Ghana's level of urbanization.

Methodology

In this analysis, we focused on two levels of urbanization classification: DEGURBA L1 and DEGURBA L2. DEGURBA stands for Degree of Urbanization, and it categorizes areas based on population density and urban characteristics. Level 1 (L1) provides a broader classification into three categories: City, Town & Semi-Dense area, and Rural Area while Level 2 (L2) offers a more granular view with seven categories.

Data

The data used for the work include 2021 population census data from the Ghana Statistical Services (GSS) and the districts shapefiles for Ghana. The toolbox used was GHS DEGURBA Toolkit Toolbox.

Results

DEGURBA L1 Classification:

- City (22.7%):** The city consists of contiguous grid cells with a density of at least 1,500 inhabitants per km². The city must have a population of at least 50,000. Gaps in this cluster are filled and edges are smoothed. Based on an analysis of Ghana's degree of urbanization, the population of the city is 6,984,044.
- Town & Semi-Dense Area (23.6%):** This classification encompasses areas with moderate population density and urban development with a population size of 7,269,939. Basically, Towns and semi-dense areas consist of contiguous grid cells with a density of at least 300 inhabitants per km² and a population of at least 5,000 in the cluster.
- Rural Area (53.8%):** The majority of Ghana's population resides in rural areas, where agriculture often serves as the primary livelihood. These regions typically have lower population densities. Most of these will have a density below 300 inhabitants per km².

Conclusion

In conclusion, understanding the degree of urbanization in Ghana is crucial for policymakers, urban planners, and development agencies. It highlights the need for targeted interventions to manage urban growth, improve infrastructure, and ensure sustainable development. Additionally, it underscores the importance of addressing rural development challenges to alleviate pressures on urban centers and promote balanced regional development. By utilizing ArcGIS Pro and spatial analysis techniques, stakeholders can gain valuable insights into population distribution, urban expansion trends, and the spatial dynamics of urbanization. This knowledge forms the basis for evidence-based decision-making and effective resource allocation to support Ghana's socio-economic progress in the years to come.



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