GIS, Google Earth Engine, and AI for Public Health – Uganda Workshop

Workshop Title: Spatial Data and Artificial Intelligence for Health Research and Planning

Duration: 3 Days (Introductory – Applied)

Audience: Public health practitioners, GIS analysts, researchers, students

Prerequisites: None (designed for beginners)

Software/Accounts Needed: QGIS (pre-installed), Google Earth Engine account, ChatGPT access (free or paid)

Workshop Objectives:

- - Understand the value of GIS and Earth observation in health research.
- - Use QGIS to map disease prevalence and health service access.
- - Use Google Earth Engine to analyze environmental risk factors.
- - Use ChatGPT to write, explain, and troubleshoot GEE scripts.
- - Apply learned skills in a small project using real or simulated public health data.

Day 1 – Foundations of GIS and Public Health – Mapping Disease and Health Service Gaps in QGIS

Learning Objectives

- Understand key GIS concepts and spatial data types relevant to public health.
- Learn basic cartographic techniques to visualize disease burden.
- Use spatial queries to explore service accessibility.
- Develop hands-on skills using QGIS with real health data.

Schedule

Time	Activity	Description
09:00–09:30	Welcome & Workshop Overview	Introduction to instructors, participants, and workshop goals.
09:30–10:15	Lecture: GIS for Health	Overview of spatial data types, projections, and GIS use cases in health.
10:15–10:30	Break	

10:30–12:00	Lab 1: Mapping Malaria Prevalence	Load district shapefiles and join malaria CSV. Create choropleth maps.
12:00–13:00	Lunch	
13:00–14:30	Lab 2: Health Facility Access & Buffer Zones	Load XY facility CSV, convert to points, buffer, and identify underserved areas.
14:30–15:30	Map Review & Discussion	Interpret outputs. Highlight gaps in care. Peer feedback encouraged.
15:30–16:00	Q&A and Wrap-Up	Summary of key concepts. Setup for Day 2 (GEE introduction).

Expected Deliverables

- 1 malaria prevalence choropleth map (PDF)
- 1 access gap analysis map with buffers and highlights (PDF)

Data Used

- Uganda district boundaries (GeoPackage)
- Malaria prevalence data (CSV)
- Health facility location data (CSV with XY coordinates)

Software

QGIS (pre-installed)

Day 2 – Earth Observation and Generative AI – Mapping Environmental Risk Factors for Malaria

Learning Objectives

- Access and visualize remote sensing data (NDVI, rainfall) using Google Earth Engine (GEE).
- Learn how ChatGPT can support scripting, analysis, and troubleshooting in GEE.
- Perform basic image processing and export outputs for use in QGIS.
- Explore clustering methods for identifying environmental health risk zones.

Schedule

Time	Activity	Description
09:00–09:30	Recap + Earth Observation for Health	Overview of environmental data in public health (NDVI, CHIRPS rainfall).

09:30–10:30	Lab 3: Visualizing NDVI and Rainfall in GEE	Load, clip, and display MODIS and CHIRPS datasets. Apply color ramps.
10:30–11:00	Break	
11:00–12:00	Lab 4: Using ChatGPT to Prompt and Write GEE Code	Write basic GEE scripts with ChatGPT. Learn debugging and explanation prompts.
12:00–13:00	Lunch	
13:00–14:30	Lab 5: AI-Based Clustering for Malaria Risk Mapping	Stack NDVI and rainfall. Use k-means clustering to identify risk zones.
14:30–15:30	Export and Visualize Cluster Maps in QGIS	Export GeoTIFF from GEE, style layers in QGIS, and interpret results.
15:30–16:00	Reflection and Discussion on AI Tools	Group discussion on advantages and challenges of AI-enhanced workflows.

Expected Deliverables

- 1 NDVI and rainfall map rendered in GEE
- 1 cluster map (risk zones) exported from GEE and styled in QGIS

Data Used

- MODIS NDVI (MOD13Q1)
- CHIRPS Rainfall (UCSB-CHG/CHIRPS)
- Uganda national boundary (LSIB dataset)

Software/Tools

- Google Earth Engine (browser)
- ChatGPT (browser)
- QGIS (optional for export visualization)

Day 3 – Independent Research Projects – Applying Spatial Tools to Public Health Challenges

Learning Objectives

- Design and conduct a GIS/GEE-based research mini-project
- Apply QGIS, GEE, and ChatGPT tools to real or simulated data
- Communicate findings through maps and concise presentations
- Reflect on challenges and strategies for applying spatial tools in health research

Schedule

Time	Activity	Description
09:00–09:30	Project Kickoff & Topic Selection	Overview of project guidelines. Select from provided topics or bring your own data.
09:30–10:30	Project Planning & Dataset Setup	Formulate a question, identify data layers, decide tools to use.
10:30–11:00	Break	
11:00–12:30	Project Work Session 1	Independent or group work with instructor and peer support.
12:30–13:30	Lunch	
13:30–15:00	Final Project Work + Presentation Preparation	Complete analysis, export visuals, prepare slides or maps.
15:00–16:00	Presentations & Wrap-Up	Short presentations (3–5 minutes). Group reflection, evaluation, next steps.

Expected Deliverables

- 1 map, slide, or short presentation showing project findings
- Participation in final discussion and feedback session

Optional Project Topics (provided)

- Mapping malaria risk zones using NDVI and rainfall clustering
- Health facility access analysis in high-burden districts
- Exploring seasonal rainfall trends and malaria incidence correlations

Software/Tools

- QGIS or Google Earth Engine
- ChatGPT (browser)