جـامعـة الشـارقـة
UNIVERSITY OF SHARJAH

College of Science – GIS and Remote Sensing

Special Topics in GIS and Remote Sensing

Assignment 3: Methodology, Data Requirements, and Task Planning

Title: Analyzing Air Pollution and Mapping Health Risk Zones in Sharjah using GIS

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1. Methodology

The methodology of this project focuses on analyzing air pollution and identifying high-risk health zones in Sharjah using ArcGIS Pro. The workflow depends completely on GIS techniques that integrate different spatial indicators representing pollution sources and population exposure. These include roads, industrial zones, and population density layers, which together help identify areas of potential health risk.

Although the first milestones mentioned the possible use of Aerosol Optical Depth (AOD) as a remote sensing indicator, this implementation focuses on more practical GIS-based layers that can be easily accessed and analyzed. This ensures the process remains realistic, simple, and achievable within the available time and data.

The work is divided into six main stages:

1. Data Collection: Collecting layers representing roads, population density, industrial zones, and the Sharjah boundary from ArcGIS Living Atlas.

2. Data Preparation: Clipping datasets to the Sharjah boundary and projecting them to WGS 1984 UTM Zone 40N for spatial consistency.

3. Spatial Analysis: Creating buffer zones around major roads and industrial areas using the Buffer tool. The population density raster is reclassified into three classes: Low, Medium, and High.

4. Weighted Overlay: Combining all layers (roads, industries, population density) using the Weighted Overlay tool. The assigned weights are: Industrial zones (40%), Roads (30%), and Population density (30%). The resulting output represents High, Medium, and Low risk areas.

5. Map Layout: Designing the final output map in Layout View, including essential map elements such as title, legend, north arrow, scale bar, and labels.

6. Validation: Verifying high-risk zones by comparing them with known industrial and densely populated regions in Sharjah.

Justification: GIS-based spatial analysis is the most efficient method for this research due to the availability of reliable spatial datasets in ArcGIS Living Atlas, the suitability of ArcGIS Pro tools, and the capability to produce accurate and replicable results.

This GIS-based approach allows spatial correlation between multiple environmental and demographic factors. By integrating industrial areas, road networks, and population data, ArcGIS Pro provides a dynamic environment to visualize pollution patterns that cannot be captured through non-spatial methods.

Workflow Summary (Flowchart Description): Data Collection → Data Preparation → Spatial Analysis → Weighted Overlay → Map Layout → Validation

2. Data Requirements

The datasets used in this project were obtained from ArcGIS Living Atlas of the World. This platform integrates verified layers from official global repositories such as USGS Earth Explorer, Copernicus Hub, WorldPop, and OpenStreetMap. Using Living Atlas ensures reliability, consistency, and seamless integration within ArcGIS Pro.

Dataset	Source	Type	Purpose
Sharjah Boundary	ArcGIS Living Atlas (Copernicus / Data.gov.ae)	Polygon	Defines study boundary
Roads	ArcGIS Living Atlas (OpenStreetMap)	Line	Represents traffic-related pollution
Industrial Zones	ArcGIS Living Atlas (Copernicus Hub)	Polygon	Shows industrial emission sources
Population Density	ArcGIS Living Atlas (WorldPop)	Raster	Represents exposure and population concentration

All data layers were accessed directly from ArcGIS Living Atlas within ArcGIS Pro.

Preprocessing includes clipping, projection to WGS 1984 UTM Zone 40N, and resampling to maintain spatial uniformity. All datasets are organized in one geodatabase for structured analysis. The selected layers provide both environmental and demographic indicators essential for assessing air pollution exposure and identifying high-risk zones across Sharjah.

3. Task Breakdown and Timeline

The following timeline provides a detailed nine-week plan designed to manage each stage of the project carefully. It allows sufficient time for data collection, processing, analysis, and final map design.

Week	Tasks	Expected Output
Week 1	Define project scope and objectives.	Final project plan.
Week 2	Collect datasets from ArcGIS Living Atlas.	Raw datasets ready.
Week 3	Organize and prepare data in ArcGIS geodatabase.	Clean datasets.
Week 4	Perform buffer analysis around roads and industrial zones.	Buffer layers completed.
Week 5	Reclassify population density and apply Weighted Overlay.	Pollution risk index map.
Week 6	Validate and compare results with known high-risk areas.	Verified outputs.
Week 7	Design final map layout in ArcGIS Pro.	Completed map design.

Week 8	Write project explanation and finalize report sections.	Draft report ready.
Week 9	Review and submit final project.	Complete submission.

4. References

Esri. (2024). ArcGIS Living Atlas of the World: Data and maps for environmental and demographic analysis. Retrieved from https://livingatlas.arcgis.com

Esri. (2023). Sharjah Administrative Boundary (Living Atlas Dataset). ArcGIS Online.

Esri. (2024). World Traffic and Road Network Dataset. ArcGIS Living Atlas.

WorldPop. (2023). Global Population Density Layer integrated in ArcGIS Living Atlas. University of Southampton.

Copernicus Hub. (2024). Global Land Cover and Industrial Area Layers (Integrated in Living Atlas). European Space Agency.

Kabir, S., & Nichol, J. (2021). Air pollution risk mapping using GIS and remote sensing: A case study in urban Asia. Environmental Monitoring and Assessment, 193(5), 295.