Site Selection Assessment

Optimizing operations – where is the best location to work?

# background

This model helps locate areas that shelters are needed due to high hazard risk and proximity to large populations, as well as finding areas in the country that would best suit shelters for disaster response. The Shelter Location Model looks at three hazards: earthquakes, flooding, and landslides as well as three serviceability: access to transportation, access to healthcare, and landcover utility to help find candidate shelter locations. Among the candidate shelter locations this model also discovers in interest where the demand is the highest for shelters comparing the hazard risk as well as the proximity to large populations.

# reference/s

* This model was piloted for the country of Haiti by the Villanova University Research Team to help low-income countries access low-cost tools to make their regions more resilient to natural disasters.
* [A Decision Process for Optimizing Multi-Hazard Shelter Location Using Global Data](https://www.mdpi.com/2071-1050/12/15/6252/htm)

# methodology

## requirements

* ArcGIS Pro License - request through [ServiceNow Form](https://crsprod.service-now.com/ess_portal/com.glideapp.servicecatalog_cat_item_view.do?v=1&sysparm_id=40ae17fc1be32410c66b8730604bcb8d&sysparm_link_parent=578a0c00db1bd700bb3f400e0b9619d7&sysparm_catalog=e0d08b13c3330100c8b837659bba8fb4&sysparm_catalog_view=catalog_default)
* Geographic Area of Interest in GIS shapefile format
* [Earthquake Data](https://earthquake.usgs.gov/data/vs30/)
* [Flood Data](https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/wrcr.20440)
* [Landslide Data](https://datacatalog.worldbank.org/dataset/global-landslide-hazard-map)
* [Road Networks Data](https://www.hotosm.org/)
* [Landcover Data](https://www.usgs.gov/centers/eros/science/usgs-eros-archive-land-cover-products-global-land-cover-characterization-glcc?qt-science_center_objects=0#qt-science_center_objects)
* Healthcare Facility Data – country-specific but you can also check [HDX](https://data.humdata.org/)
* Satellite Imagery – for base map reference of data

*Note: You can add other serviceable facilities data (transportation, evacuation centers, etc.) and customize depending on your needs. For* ***earthquake, flood, landslide, road,*** *and* ***land cover****, data sources may vary according to country or if a better imagery/vector resolution is available.*

## technical process

Requirements Checklist

* ArcGIS Pro License - request through [ServiceNow Form](https://crsprod.service-now.com/ess_portal/com.glideapp.servicecatalog_cat_item_view.do?v=1&sysparm_id=40ae17fc1be32410c66b8730604bcb8d&sysparm_link_parent=578a0c00db1bd700bb3f400e0b9619d7&sysparm_catalog=e0d08b13c3330100c8b837659bba8fb4&sysparm_catalog_view=catalog_default)
* Geographic Area of Interest in GIS shapefile format
* Earthquake Data in GIS raster format
* Flood Data in GIS raster format
* Landslide Data in GIS raster format
* Road Networks in GIS shapefile format
* Landcover in GIS shapefile or raster format
* Health Facilities in GIS shapefile format
* (OPTIONAL) Geographic locations (GPS points) of Household / Other Serviceable Facilities – make sure to set your accuracy less than 15 meters or less
  + CommCare: [Automatic GPS Capture](https://confluence.dimagi.com/display/commcarepublic/Automatic+GPS+Capture) to activate GPS data collection.
  + RedRose: contact your Regional ICT4D Solutions Engineer or Red Rose representative

### ARCGIS PRO

* Download the Toolbox model here: <https://bit.ly/siteselectionassess>
* ![Graphical user interface, text, application, email

  Description automatically generated]()Create your new project by opening ArcGIS Pro and then select New > Blank Templates > Map. Input the name of your new project and select the location folder you want it saved.

![Graphical user interface, application, Word

Description automatically generated]()

* Go to Insert > Toolbox > look for where you saved your toolbox.
* Prepare your datasets and add it to your map:
  + Country/study area raster
  + Area of interest border: [GADM](https://gadm.org/)
  + Global raster – VS30: [Earthquake data](https://earthquake.usgs.gov/data/vs30/)
  + Global raster – Fluvial/costal flood: [Flood data](https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/wrcr.20440)
  + Global raster – Landslide susceptibility: [Landslide data](https://datacatalog.worldbank.org/dataset/global-landslide-hazard-map)
  + Healthcare facilities: Healthcare facility data- country specific public health data
  + Roads: [Road data Open Street Map](https://www.hotosm.org/)
  + Land cover raster: [Landcover data](https://www.usgs.gov/centers/eros/science/usgs-eros-archive-land-cover-products-global-land-cover-characterization-glcc?qt-science_center_objects=0#qt-science_center_objects)
  + Population points: Population point data – country specific data
* Open attribute table for healthcare facilities, add a field and call it **Population\_PD**
* Open attribute table for roads, add a field and call it **Roads\_LD**
* ![Table

  Description automatically generated]()Create your hazard remap tables by creating an excel table that shows old lower values and old upper values of a raster and assign values to intervals to show low, moderate, or high susceptibility for hazard.
  + Create a remap table for flood layer and name **Flood\_remap**
  + Create a remap table for landslide layer and name **LS\_remap**
* ![Table

  Description automatically generated]()Creating serviceability tables by creating an excel table that shows old lower values and old upper values of a raster and assign values to intervals that show high, moderate, low suitability for infrastructure.
  + Create remap table for healthcare layer and name **HC\_remap**
  + Create remap table for road layer and name **Road\_remap**
  + Create remap table for landcover layer and name **LC\_remap**

*Note: Remap values are assigned based on the consideration/decision on what should be considered low, moderate, or high risk/suitability. Seek additional support from the Data and Geospatial Analytics Team from GKIM-ICT4D if needed or if there’s a professional who has a background or knowledge about this.*

* *Graphical user interface, application

  Description automatically generated*Start setting up your model by opening your added toolbox named **Multi-Hazard Shelter Location.tbx** > right-click on Site Selection Assessment and then click Edit. The model should open on your main panel. Follow steps below:
  + Right click on and open **PGA clip tool:**
    - Input: change input layer to the layer of the country being studied
    - Output extent: change to area of interest border for the country being studied
    - ![Table

      Description automatically generated]()Output raster dataset: save output of this tool to folder created for this project
  + Right click on and open **Standardize PGA tool:**
    - Input: result of PGA clip tool
    - Reclass field: Value
    - Reclass values: 1-5
  + Right click on and open **VS30 clip tool:**
    - Input: VS30 global raster for earthquakes
    - Output extent: change to area of interest border for the country being studied
    - ![Table

      Description automatically generated]()Output raster dataset: save output of this tool to folder created for this project
  + Right click on and open **Standardize VS30 tool:**
    - Input: result of VS30 clip tool
    - Reclass field: value
    - Reclass values 5-1
  + Right click on and open **flood clip tool:**
    - Input: fluvial/coastal flood global raster
    - Output extent: change to area of interest border for the country being studied
    - Output raster dataset: save output of this tool to folder created for this project
  + Right click on and open **standardize flood tool:** 
    - Input raster: result of flood clip tool
    - Input remap table: Flood\_remap
    - From value field: OLD\_LOWER
    - To value field: OLD\_UPPER
    - Output value field: NEW
    - Output raster: save output of this tool to folder created for this project
  + Right click on and open **landslide clip tool:**
    - Input: landslide global raster
    - Output extent: change to area of interest border for the country being studied
    - Output raster dataset: save output of this tool to folder created for this project
  + Right click on and open **standardize landslide tool:**
    - Input raster: result of landslide clip tool
    - From value field: OLD\_LOWER
* To value field: OLD\_UPPER
* Output value field: NEW
* Output raster: save output of this tool to folder created for this project
* Right click on and open **point density tool:**
  + Input: Healthcare facilities layer found for country of interest
  + Population field: Population\_PD (added field in healthcare facilities attribute table)
  + Output raster: save output of this tool to folder created for this project
* Right click on and open **healthcare density clip tool:**
  + Input: healthcare point density layer created in step
  + Output extent: change to area of interest border for country being studied
  + Output raster dataset: save output of this tool to folder created for this project
* Right click on and open **standardize healthcare metric tool:**
  + Input raster: result of healthcare density clip tool
  + Input remap table: HC\_emap
  + From value field: OLD\_LOWER
  + To value field: OLD\_UPPER
  + Output value field: NEW
  + Output raster: save output of this tool to folder created for this project
* Right click on and open **line density tool:**
  + Input: roads layer found for country of interest
  + Population field: Roads\_LD (added field in roads attribute table)
  + Output raster: save output of this tool to folder created for this project
* Right click on and open **road density clip tool:**
  + Input: road density layer
  + Output extent: change to area of interest border for country being studied
  + Output raster dataset: save output of this tool to folder created for this project
* Right click on and open **standardize transportation metric tool:**
  + Input raster: result of road density clip tool
  + Input remap table: Road\_ emap
  + From value field: OLD\_LOWER
  + To value field: OLD\_UPPER
  + Output value field: NEW
  + Output raster: save output of this tool to folder created for this project
* Right click on and open **landcover clip tool:**
  + Input: land cover global raster
  + Output extent: change to area of interest border for country being studied
  + Output raster dataset: save output of this tool to folder created for this project
* Right click on and open **standardize land use metric tool:**
  + Input raster: result of landcover clip tool
  + Input remap table: LC\_remap
  + From value field: OLD\_LOWER
  + To value field: OLD\_UPPER
  + Output value field: NEW
  + Output raster: save output of this tool to folder created for this project
* Right click on and open **make feature layer tool:**
  + Input features: populations points data
  + Output layer: population points layer
  + Save layer to folder created for project
* To ensure there will be no output workspace errors right click on and open all tools in model and make sure the output raster/layer will be saved to folder created for project. At top of page when working in the model builder, under model builder ribbon click Run to run model. Result data should be added to map to view.

Word

Description automatically generated with medium confidence

### ARCGIS ONLINE (SERVER/PORTAL)

* Open ArcGIS Online Map (\*link to follow once ArcGIS Server is working properly\*)
* Input requested parameters/datasets
  + Area of interest administrative boundary (.shp)
  + Earthquake Data (raster)
  + Flood Data (raster)
  + Landslide Data (raster)
  + Road Networks (.shp – line)
  + Landcover (raster or .shp – polygon)
  + Health Facilities (.shp – point)
  + (OPTIONAL) Population Data / Other Serviceable Facilities
* Click Run. Results can then be viewed in the online map or exported as an ArcGIS shapefile or Google Earth file (.kml/.kmz)
* Publish your featured layer on your ArcGIS Online Dashboard and update when needed.

## technical modifications

For customizations, download the Toolbox model here: <https://bit.ly/siteselectionassess> and instead of selecting Open select Edit to change parameters according to program needs. Sample modifications on the tool can be:

* + Add / Delete / Edit Hazard Data or Serviceability Facility Data
  + Add existing household GPS locations for overlay and additional analysis

# planning

## technical costs

* Storage costs (costs are applied every storage hour)
  + $100 for every 4GB of **road and serviceability facilities data**(vector layer) stored on ArcGIS Online per month.
  + $100 for every 830GB of **raster hazards** (raster layer) per month.
* Satellite imagery cost
  + Depends on availability and resolution. To know more check our [one-pager for Satellite Imagery](https://crsorg.sharepoint.com/sites/Knowledge-and-Innovation/SitePages/Satellite-Imagery.aspx).
* Staff Support
  + Data and Geospatial Analytics Team provides **Spatial Analytics** support with **no charge back** for work < 80 hours. Fill out an [**ICT4D Services Support Request Form**](http://bit.ly/2CUNGLZ)for us to discuss over a call.

## time frame

* Data Requirements: 1 day to 1 week (depending on source availability)
  + (OPTIONAL) Household GPS Locations: 1 day to 1 week (data preprocessing and cleaning by CP or Project Team)
* Data Setup in ArcGIS Pro: 1 to 3 days
* Data Setup in ArcGIS Online: 1 hour to 1 day
* Run Setup: 1 hour to 1 day (depends on building data and HH GPS size)