Case study- Spatial risk assessment for incursion and spread of foot and mouth disease in Myanmar- Day 04

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August 2021

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1 Review

The processes to this point have completed SRA-GIS steps up to and including Step 4 (Figure 1.1). The final two steps involves combining the spatial risk layers into a single risk surface and critical evaluation of the final SRA map.

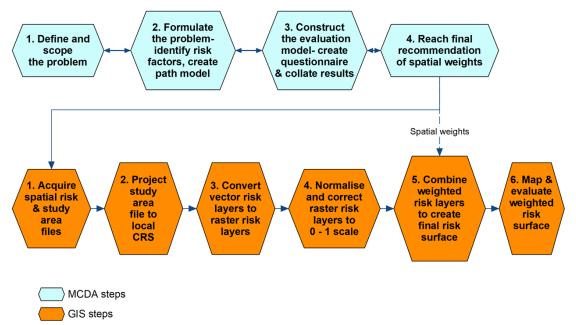


Figure 1.1: Spatial risk assessment steps

2 Create final raster risk layer

- Apply MCDA weights to each final risk factor layer for FMD occurrence and add together to create a final raster layer. Use the following MCDA weights: Major roads = 0.18, Minor roads = 0.18, Cattle population density = 0.24, Pig population density = 0.18, Livestock markets = 0.40. See Figure 2.1.
 - 1. Menu Bar: Raster -> Raster Calculator -> Dialog box:
 - 1. Output layer: "RiskFactorWgtd" in "ResData-Final" folder
 - 2. Raster Calculator Expression: Add together weighted risk layers
 - 3. Click OK

| ter Bands | | | | Result Lay | /er | | | | |
|--------------|------------------------------------|----------|--|------------|------------------|----------------|--------------|------------------------------|--------|
| | sActv_Rast_Norm | | | Output la | yer | sData\Geo-f | Final\RiskFa | actorWgtd.tif 🖾 |] [|
| | sActv_Rast_Norm | _NoNA@1 | | <u> </u> | | | | | |
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| MMRRoadsS | | 1 | | | | | | | |
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| /IMR_0_0@1 | | | | Output O | RS | EPSG:32646 | 5 - WGS 84 | /UTM zone 46 🔻 | |
| /MR_0@1 | | | | | | | | | |
| ig_2010_Da | | | | ✓ Add r | esult to project | | | | |
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| - | | ^ | acos | asin | atan | | In |) | |
| < | > | = | != | <= | >= | | AND | OR | |
| abs | min | max | | | | | | | |
| 1MRRoadsPrin | | | + ("MMRRoadsSec_ arketsActv_Rast_No | | |). 18) + ("Cat | ttle_2010_1 | Da_Clip_Norm@1" [;] | * 0.24 |
| | | | | | | | | | _ |
| | | 2 | | | | | | | |
| | | 2 | | | | | | | |

Figure 2.1: Combining weighted risk layers

- 2. Clip raster to the study area (see Figure Figure 2.2).
 - 1. Menu Bar: Raster -> Extraction -> Clip raster by mask layer... -> Dialog box:
 - 1. Input layer: "RiskFactorWgtd"
 - 2. Mask layer: MMR_0
 - 3. Click Run

| Q Clip Raster by Mask Layer | | | × |
|--|-----|-------|----------|
| Parameters Log 1 | | | |
| Input layer | | | <u> </u> |
| RiskFactorWgtd [EPSG:32646] | | | - |
| Mask layer | | | |
| MMR_0 [EPSG: 32646] | | - C | ୬ |
| Selected features only | | | |
| Source CRS [optional] | | | |
| | | | - 🌚 |
| Target CRS [optional] | | | |
| | | | - 🌚 |
| Assign a specified nodata value to output bands [optional] | | | |
| Not set | | | - |
| Create an output alpha band | | | |
| \checkmark Match the extent of the dipped raster to the extent of the mask layer | | | |
| Keep resolution of input raster | | | |
| Set output file resolution | | | |
| X Resolution to output bands [optional] | | | |
| | | | |
| 0% | 3 | | Cancel |
| Run as Batch Process | Run | Close | Help |
| Rui as baiul Flotess | Kun | Ciose | nep |

Figure 2.2: Clipping final raster risk surface to study boundary

- 2. (continued)
 - 2. Save clipped final risk factor layer with a new name
 - 1. Right click newly-created clipped RiskFactorLayer: Export -> Save As ... Dialog box
 - 1. File name: "RiskFactorWgtd_clip" in "ResData-Final" folder
 - 2. View final risk map in map palette (see Figure 2.3)

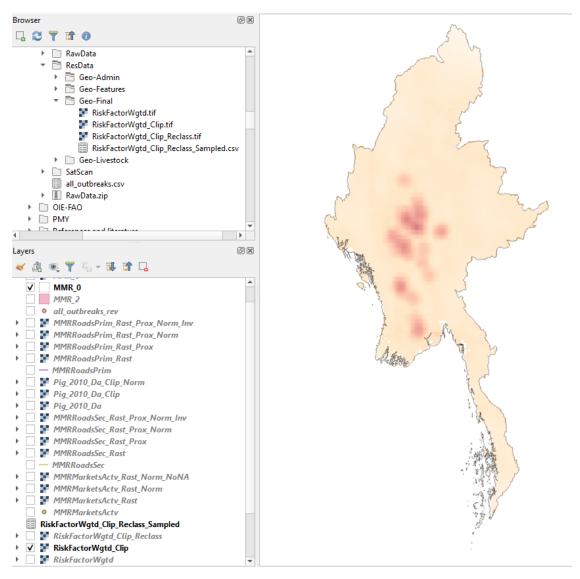


Figure 2.3: Clipping final raster risk surface to study boundary

3 Map and evaluate the weighted risk surface

- 1. Create a new shape file of FMD case locations to add to the final risk map to assess how accurately the final risk map has predicted the location of FMD case villages
 - 1. Copy locations of villages with FMD outbreaks (all_outbreaks_rev.csv) into the "-Features" folder with Windows File Explorer
 - Click Open Source Data Manager on Toolbox Menu Bar -> Dialog box (Figure 3.1)
 - 1. Ensure "Delimited Text" option is highlighted
 - 2. Select Folder button and then file name
 - 3. Check default File Format and Record and Field Options are correct
 - 4. Check Geometry Definition settings are correct for the imported file

| | 5. | Click "Add" |
|-----------------------------------|--------|---|
| Q Data Source Manager Delimited | d Text | × |
| 📙 Browser | 2 | 🕇 File name [yWork\Consulting\SEACFMDGISCourse2021\CourseNotes\Data\MMR-FMD-new\RawData\Geo-Features\all_outbreaks_rev.csv 🚳] 🛄 |
| V. Vector | 2 | Layer name all_outbreaks_rev Encoding UTF-8 |
| Raster | | ▼ File Format |
| Mesh 1 | | CSV (comma separated values) |
| | | Regular expression delimiter |
| Delimited Text | | O Custom delimiters |
| 🙀 GeoPackage | | ▼ Record and Fields Options |
| 🖊 SpatiaLite | 3 | Number of header lines to discard 0 Decimal separator is comma |
| PostgreSQL | | ✓ First record has field names |
| MSSQL | | Detect field types Discard empty fields |
| Q Oracle | | ▼ Geometry Definition |
| DB2 DB2 | 4 | Point coordinates X field Longitude T Z field |
| Virtual Layer | 4 | Well known text (WKT) Y field Latitude M field T |
| | | DMS coordinates No geometry (attribute only table) Geometry (attribute only table) Geometry (attribute only table) |
| C wms/wmts | | No geometry (attribute only table) Geometry CRS EPSG:4326 - WGS 84 |
| WFS / OGC API - Features | | Layer Settings |
| æ wcs | | Sample Data |
| | | X Y Sr No Division/S D_Pcode District TS_Pcode Township VT_Pcc* |
| XYZ | | 1 95.87597656 17.51771927 199 Yangon MMR013D001 Yangon (North) MMR013005 Taikkyi MMR0130 2 95.83400726 17.55142021 200 Yangon MMR013D001 Yangon (North) MMR013005 Taikkyi MMR013C |
| Vector Tile | | |
| Rec GIS Map Service | | Close <u>A</u> dd Help |

Figure 3.1: Import village outbreak locations and create a shape file

(continued) 1.

- 3. Reproject and save newly-added "all_outbreaks_rev" shape file
 - In Layers Pane Highlight and right-click "all_outbreaks_rev" 1.
 - 2. Select Export -> Save Features As ... -> Dialog box (Figure 3.2)
 - Select "ResData-Features" folder and file 1. name"all_outbreaks_rev"
 - 2. CRS: Select Project CRS: EPSG:32646 - WGS 84 /UTM zone 46N
 - 3. Click OK

| Q Save Vect | or Layer as | | | | × |
|--|------------------------------------|-------------|---------------------|-------------------|----------|
| Format | ESRI Shapefile | | 1 | | - |
| File name | se2021\CourseNotes\Data\MMR-FMD- | new\ResDat | a\Geo-Features\all_ | outbreaks_rev.shp | ⊠] |
| CRS | Project CRS: EPSG:32646 - WGS 84 / | UTM zone 4 | 6N | | |
| Encoding | 2 ly selected features | UTF-8 | | | • |
| Select Geometry | fields to export and their export | options | | | |
| Geometry | | Auto | matic | | - |
| | multi-type | | | | |
| | e z-dimension | | | | |
| ▶ Ext | ent (current: none) Options | | | | |
| RESIZE | | | | | - |
| SHPT | - Onlines | | | | • |
| p Custor | n Options | | | | |
| | | | 3 | | |
| | ✓ Add saved | file to map | ОК | Cancel | Help |

Figure 3.2: Reproject and save village outbreak locations shape file

- 1. (continued)
 - 4. Arrange map layers in Layers pane so that only the final weighted risk map clipped to the country boundary (RiskFactorWgtd_Clip) and the case locations are displayed (Figure 3.3).

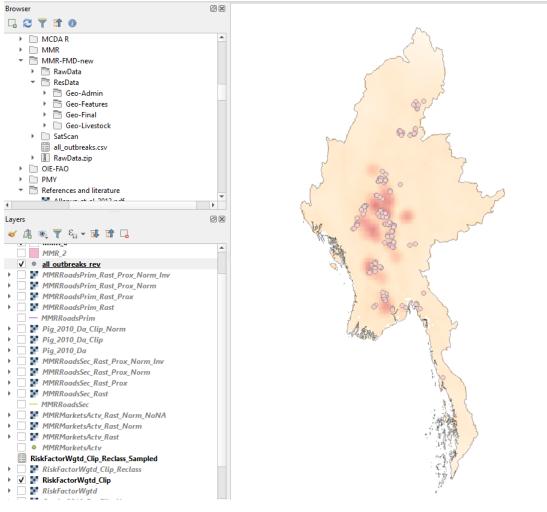


Figure 3.3: Reproject and save village outbreak locations shape file

- 2. Reclassify the final risk map into high (>= 0.5) and low (<=0.5) risk zones to make interpretation easier for decision-makers
 - 1. Processing Toolbox -> Raster analysis -> Reclassify by table (Double click) -> Dialog box (Figure 3.4).
 - 1. Raster layer: Select "RiskFactorWgtd_clip"

| Parameters Log | | Reclassify | , by table | |
|---|----|---------------------|--|--------|
| Raster layer | | | | |
| RiskFactorWgtd_Clip [EPSG:32646] | | assigning new cla | lassifies a raster b iss values based o | |
| and number | | specified in a fixe | d table. | |
| Band 1 (Gray) | • | | | |
| Reclassification table | | | | |
| Fixed table (0x3) | | | | |
| Advanced Parameters | | | | |
| Output no data value | | | | |
| -9999.000000 | \$ | 1 | | |
| Range boundaries | | | | |
| min < value <= max | - | | | |
| Use no data when no range matches value Output data type | | | | |
| Float32 | • | | | |
| Reclassified raster | | | | |
| [Save to temporary file] | • | | | |
| 0% | | | | Cancel |
| | | | | |

Figure 3.4: Raster reclassification dialog box

2.

- 1. (continued)
 - 2. Reclassification table: Click "..." button to right and pop-up "Reclassification Table" appears (Figure 3.5)
 - 1. Click Add Row and double click in cells Minimum: 0, Maximum: 0.5, Value: 0
 - 2. Click Add Row and double click in cells Minimum: 0.5, Maximum: 1, Value: 1
 - 3. Click OK

| Reclassify by Table | | | | 4 | > |
|---------------------|---------|-------|---------------|--|---------------|
| Parameters Log | | | | Reclassify by table | |
| Reclassification | table | | | This algorithm reclassifies a raster assigning new class values based of | band by |
| Minimum | Maximum | Value | Add Row | specified in a fixed table. | in all ranges |
| 1 0 | 0.5 | 0 | Remove Row(s) | | |
| 2 0.5 | 1 | 1 | Remove All | | |
| | | | ОК | | |
| | | | Cancel | | |
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| | | 0% | | | Cancel |
| n as Batch Process. | | | | Run Close | Help |

Figure 3.5: Raster reclassification table

2.

- 1. (continued)
 - 3. Return to dialog box (Figure 3.6)
 - 1. Reclassified raster item: Click "…" button to right -> Save to file and rename the output file in the "ResData/Geo-Final/" folder as "RiskFactorWgtd_Clip_Reclass"
 - 2. Click Run
 - 3. Click Close

| Reclassify by Table | | | | | |
|---|---|---|---------------------------|----------|---------------|
| Parameters Log | | ٩ | Reclassify | by table | |
| RiskFactorWgtd_Clip [EPSG:32646] | • | | - This algorithm recla | | band by |
| Band number | ۲ | | assigning new class | | on the ranges |
| Band 1 (Gray) | | | | | |
| Reclassification table | | | | | |
| Fixed table (2x3) | | | | | |
| Advanced Parameters | | | | | |
| Output no data value | | | | | |
| -9999.000000 | | | | | |
| Range boundaries | | | | | |
| min < value <= max 💌 | | | | | |
| Use no data when no range matches value | | | | | |
| Output data type | | | | | |
| Float32 | 1 | 1 | | | |
| Reclassified raster | - | J | | | |
| eNotes/Data/MMR-FMD-new/ResData/Geo-Final/RiskFactorWgtd_Clip_Reclass.tif | | | | | |
| ✓ Open output file after running algorithm | ļ | | | | |
| | | | 2 | 3 | |
| 0% | _ | | | | Cancel |
| un as Batch Process | | | Run | Close | Help |

Figure 3.6: Rename and save reclassified file

- 3. Validate SRA map against recorded outbreaks/cases
 - Calculate the proportion of outbreaks/cases in the high risk (risk probability >= 0.5) zone
 - 1. In Layers pane highlight "RiskFactorWgtd_Clip_Reclass"
 - 2. Processing Toolbox -> Raster analysis -> Sample Raster Values (double click) -> dialog box: (Figure 3.7)
 - Input Layer -> Click "…" button to far right and select the projected vector layer for outbreak locations "all_outbreaks_rev [EPSG:32646]" in the "ResData/Geo-Features/" folder
 - 2. Raster layer: "RiskFactorWgtd_Clip_Reclass [EPSG:32646]"
 - 3. Sampled: Save to file: Create a new CSV file of the results of this analysis in ResData/Geo-Final: RiskFactorWgtd_Clip_Reclass_Sampled.csv
 - 4. Click "Run" and then "Close"

| Q Sample Raster Values | × |
|--|--|
| Parameters Log | Sample raster values |
| Input layer C:/Jsers/cwcompto/Documents/MasseyWork/Consulting/SEACFMDGISCourse2021/CourseNotes/Data/MMR-FMD-new/ResData/Geo-Features/al_outbreaks_rev.shp 💦 💎 🗔 | This algorithm creates a new vector layer with the same attributes of the input layer and the raster values corresponding on the point location. |
| Raster layer only Raster layer only Raster layer | If the raster layer has more than one band, all the band values are sampled. |
| Output coulim pretix (optional) SAMPLE_ | |
| Sampled C:/Jsers/cwcompto/Documents/MasseyWork/Consulting/SEACFMDGISCourse2021/CourseNotes/Data/MMR-FMD-new/ResData/Geo-Final/RiskFactorWgtd_Clip_Reclass_Sampled.csv 🖉 🗌 | |
| | |
| | |
| | |
| 0% | Cancel |
| Run as Batch Process 4 | Run Close Help |

Figure 3.7: Rename and save outbreak location csv file with villages classified as present in high or low risk zones

3.

- 1. (continued)
 - 3. Open "RiskFactorWgtd_Clip_Reclass_Sampled.csv" (will be Read-Only)
 - Count the number of rows for which there is no Longitude and Latitude value, and therefore no result in the SAMPLE_1 column by filtering for Blanks (n = 10) then Clear Filter
 - 2. In cell below last row of column "SAMPLE_1" insert a function to sum all the values in the column (sum = 70)
 - 3. Calculate the number of rows with non-missing coordinates (188 10 = 178)
 - 4. Proportion of proportion of outbreaks/cases in the high risk (risk probability >= 0.5) zone = 70/178 = 39%

Exercise 3.1 (Critically evaluate of the spatial risk assessment map) Questions:

- 1. Are the most important risk factors for which information is available for accounted for in the SRA map?
- 2. Of the risk factors evaluated, could the parameters be changed to improve the accuracy of the SRA map e.g. diameter of smoothing of heat map of livestock markets density?
- 3. Is there a possibility of information/reporting bias affecting our SRA map?
- 4. What additional data could be gathered to improve our SRA?