Spatial Risk Assessment on the Incursion and Initial Spread of African Swine Fever (ASF) in the Philippines

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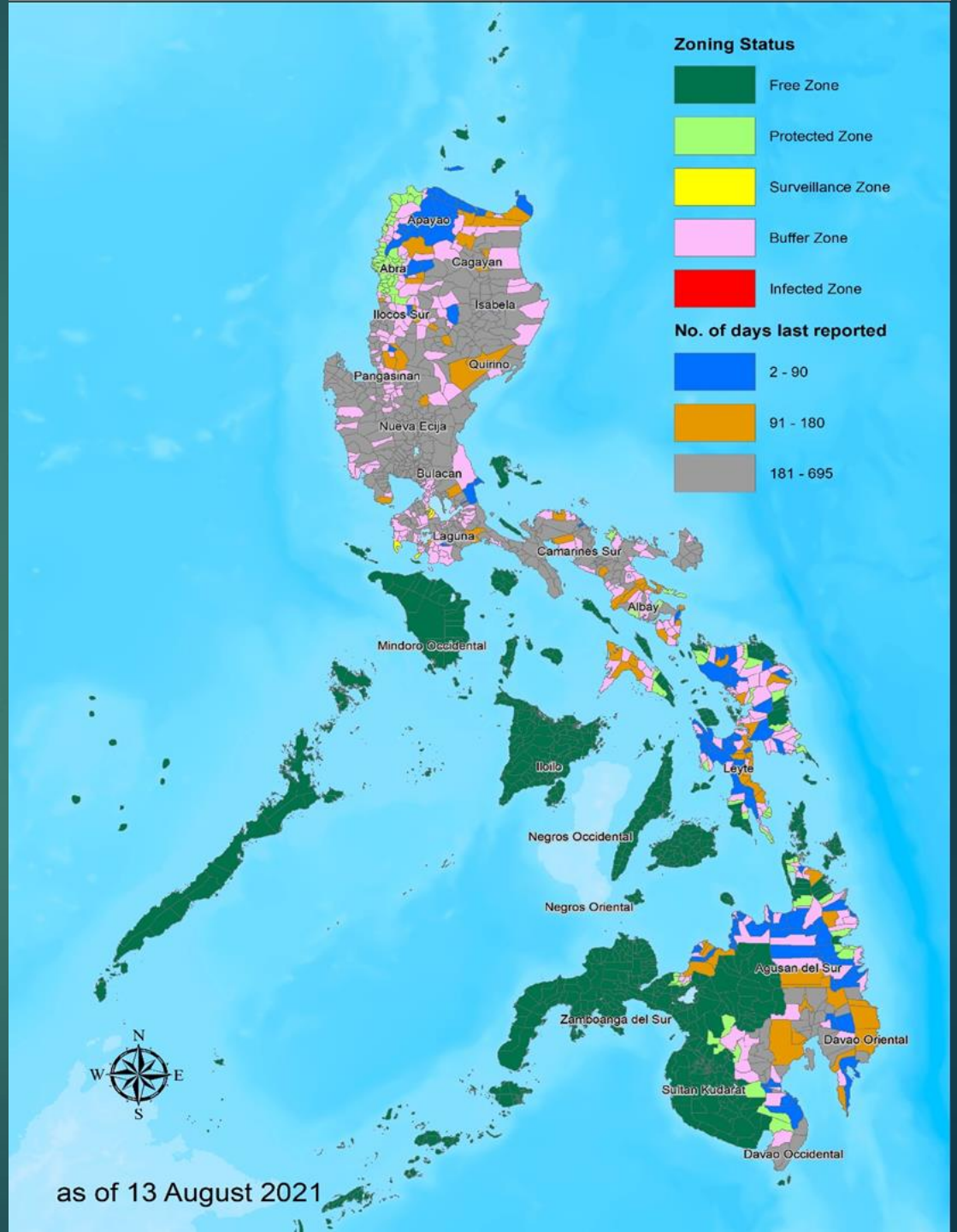
Status of ASF in the Philippines

- The Philippines reported its first case of ASF in July 2019 affecting several backyard farmers in Rodriguez, Rizal.

- Since then the disease has spread to nearby provinces and has now affected a total of 50 provinces:
  - 37 in Luzon;
  - 5 in Visayas; and
  - 8 in Mindanao

- Recovery and Repopulation efforts in previously affected areas are now being instituted.



Economic Impact

PSA SOW LEVEL

Particulars	Pre-ASF July 1, 2019	1 October 2020	% Difference	Sow lost
Total Sow Level	**1,769,309**	**1,514,373**	**-13%**	**227,936**
Backyard	1,105,595	1,076,982	-3%	28,613
Commercial	663,714	464,391	-30%	199,323

PSA Data

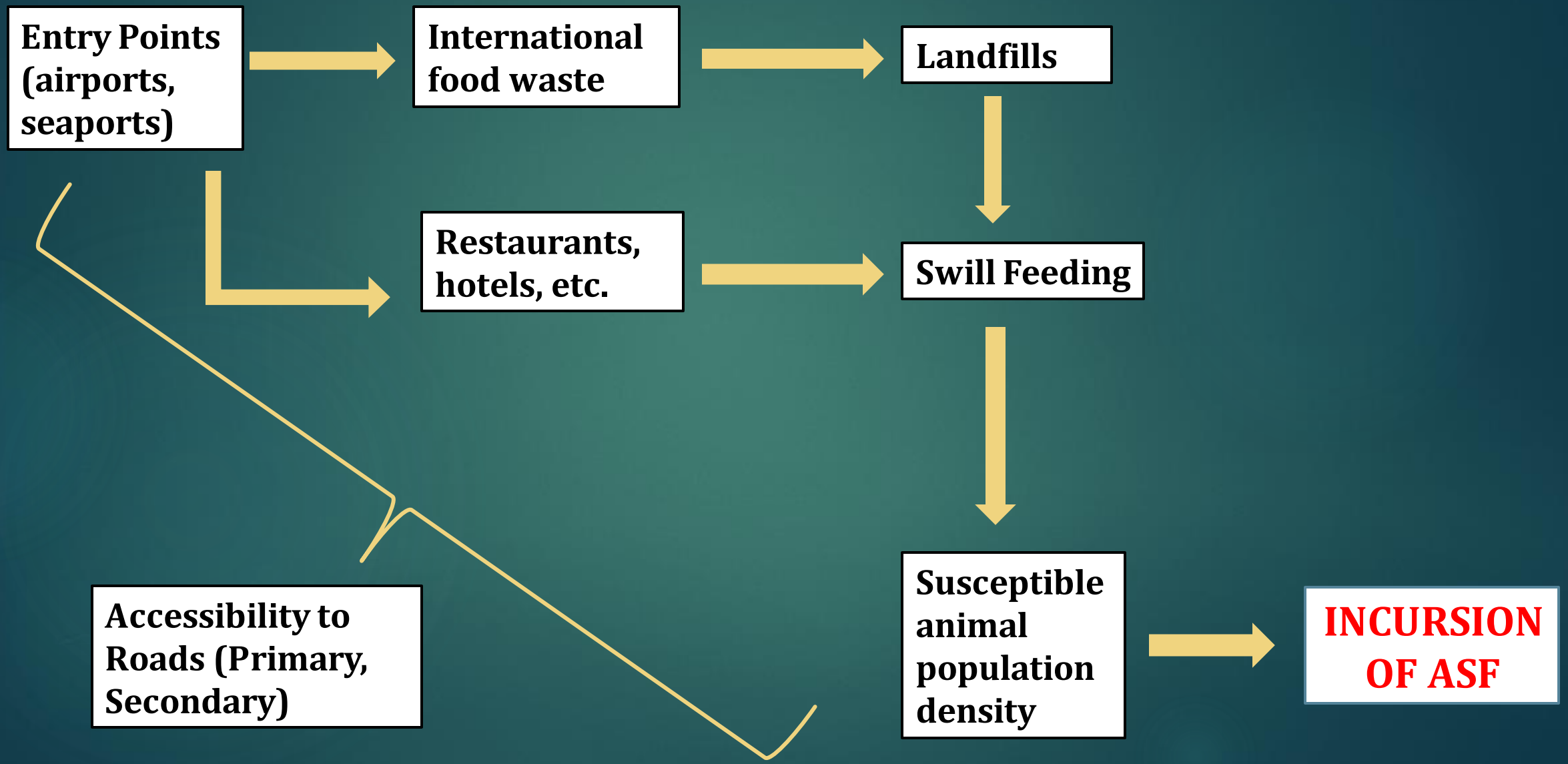
Objectives

- To establish the pathway of incursion of ASF in the Philippines
- To study the risk factors that possibly led to the incursion of ASF in the Philippines

Risk Factors

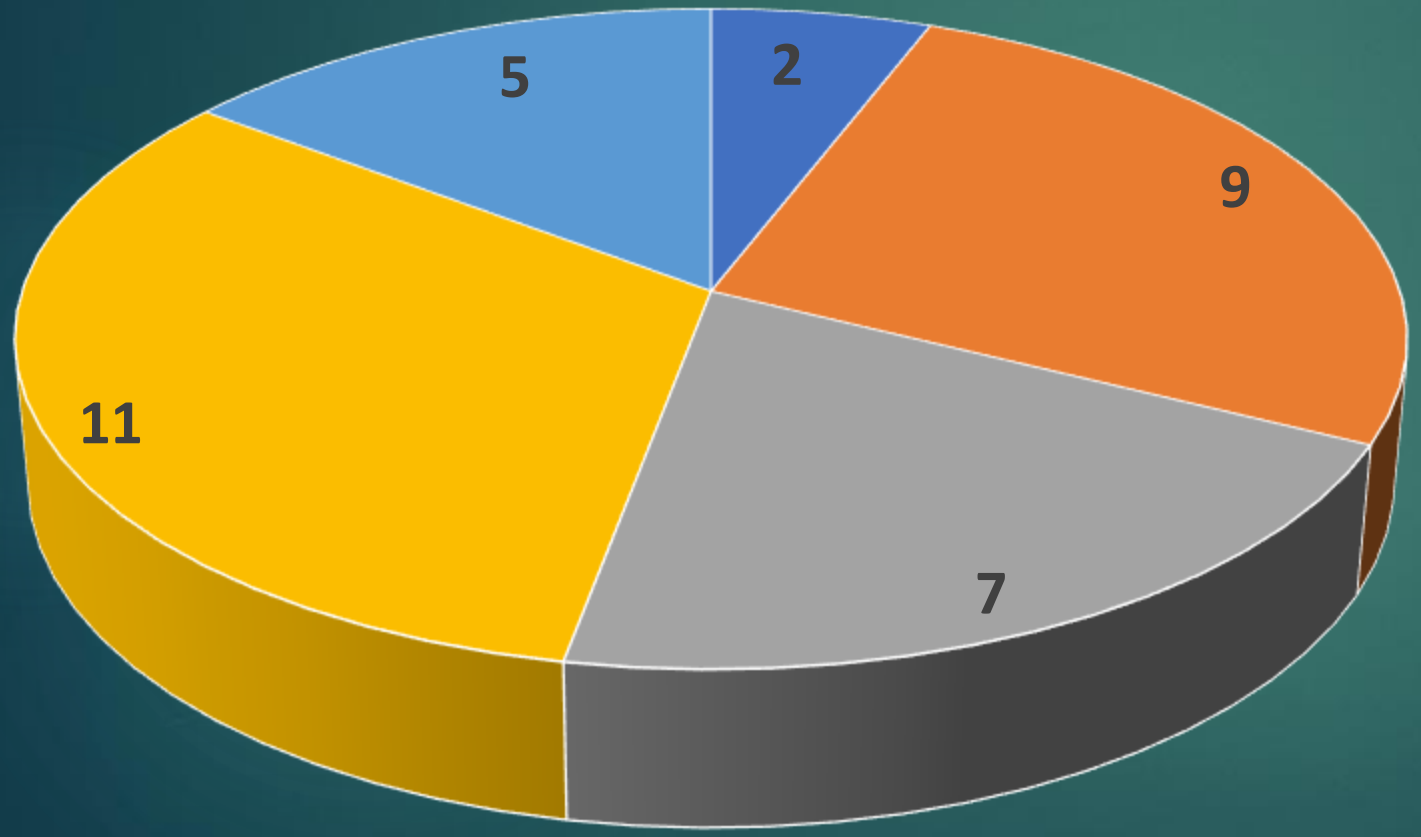
	Risk Factors	Level of Risk	Description
1	Pig Population Density (per sq. km)		
2	Accessibility to Roads (Primary, secondary)		
3	Provinces Practicing Swill Feeding (Level of Risk attributed to sources of swill feed)	1	Swill feeding is not being practice
		2	Swill feed from own household leftovers/acquired within the barangay
		3	Swill feed acquired outside barangay (village)
		4	Swill feed acquired from hotel/restaurants/food establishment within municipality (town)
		5	Swill feed acquired from hotel/restaurants/food establishment outside municipality (town)
4	Location of Landfills (Level of Risk attributed to waste arrival (tons) per day)	1	Low (≤100)
		2	Medium (101-1000)
		3	High (1001-5000)
		4	Very High (>5000)
5	Entry Points (Airports, Seaports) (Level of Risk attributed to average volume of pork importation (kg) from 2018-2020)	1	Negligible (No Pork Arrival)
		2	Low risk
		3	Medium risk
		4	High risk
		5	Very High Risk

Path Model for ASF Incursion



Questionnaire for the MCDA Method

RESPONDENTS



Multi-Criteria Decision Aiding (MCDA) Method for Spatial Risk Assessment on ASF

Dear Colleagues,

A group of BAI technical staff is currently involved in a Spatial Risk Assessment (SRA) training program wherein the expected output is to identify the most likely risk factor involved in the route of entry of ASF into the country. The group has selected to work on African Swine Fever (ASF) as subject of interest.

Multi-criteria decision aiding (MCDA) provides a range of methods to reach a decision when multiple, and possibly conflicting criteria must be taken into account (Bigaret et al. 2017). In an assessment of spatial risk factors, the term "risk factors" might be used instead of "criteria."

1. When comparing location of entry points (airports, seaports) and Pig population density for the incursion of ASF in the Philippines, location of entry points (airports, seaports) is

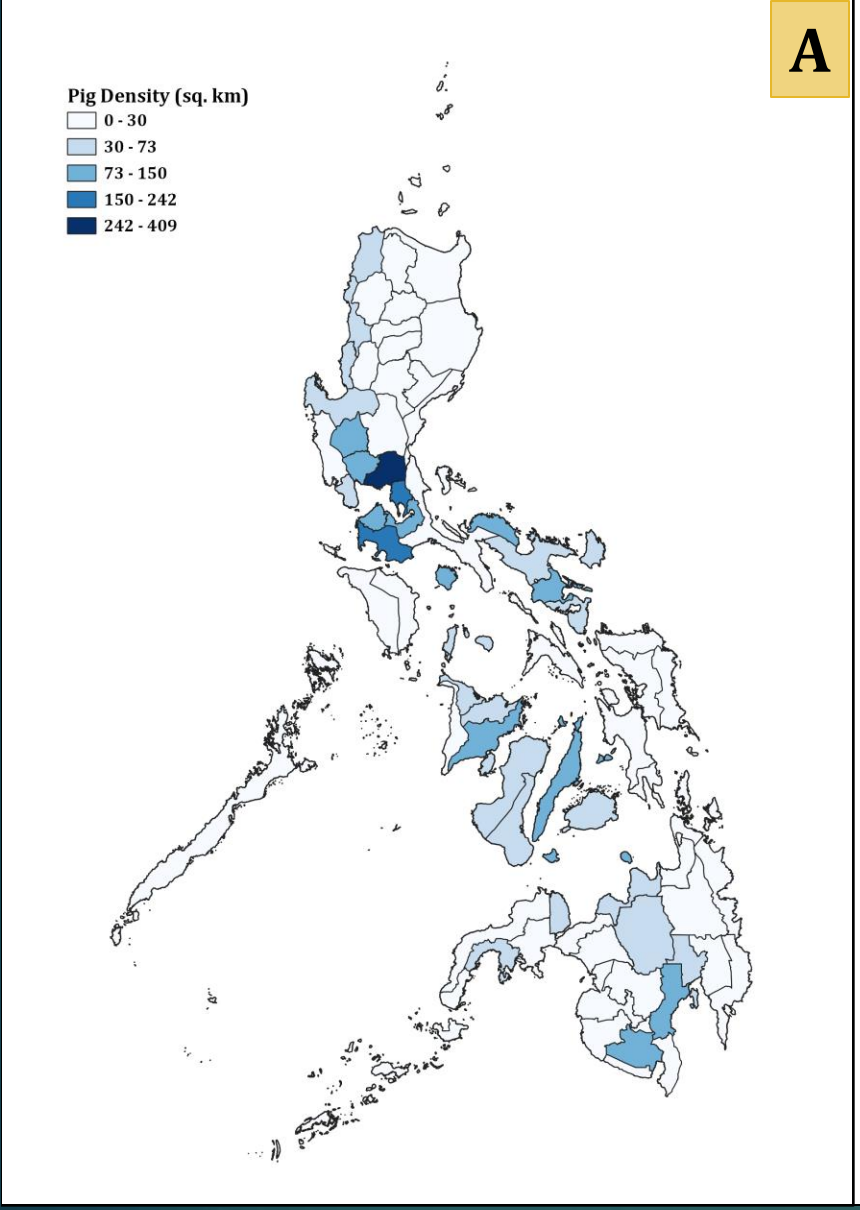
- extremely less important
- very strongly less important
- strongly less important
- moderately less important
- equally important
- moderately more important
- strongly more important
- very strongly more important
- extremely more important

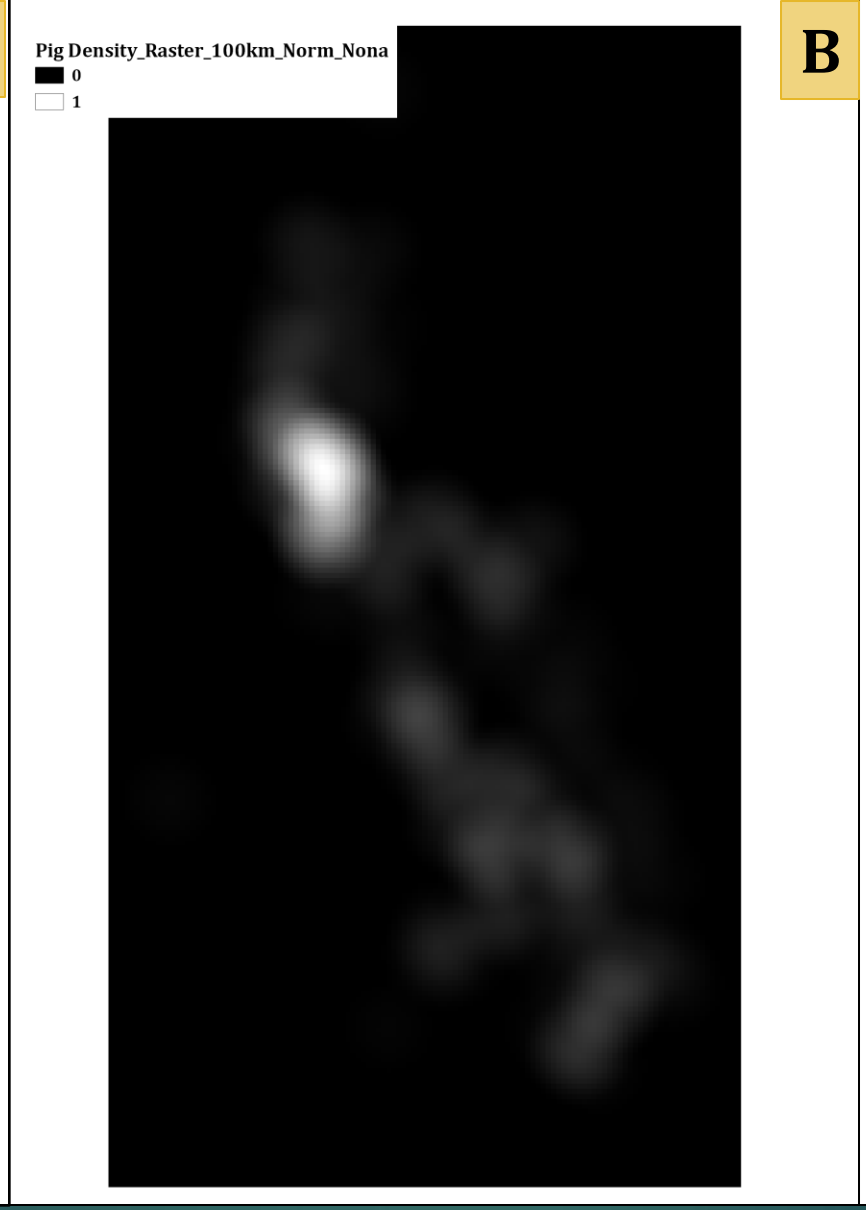
Median Scores for Risk Factor Comparisons

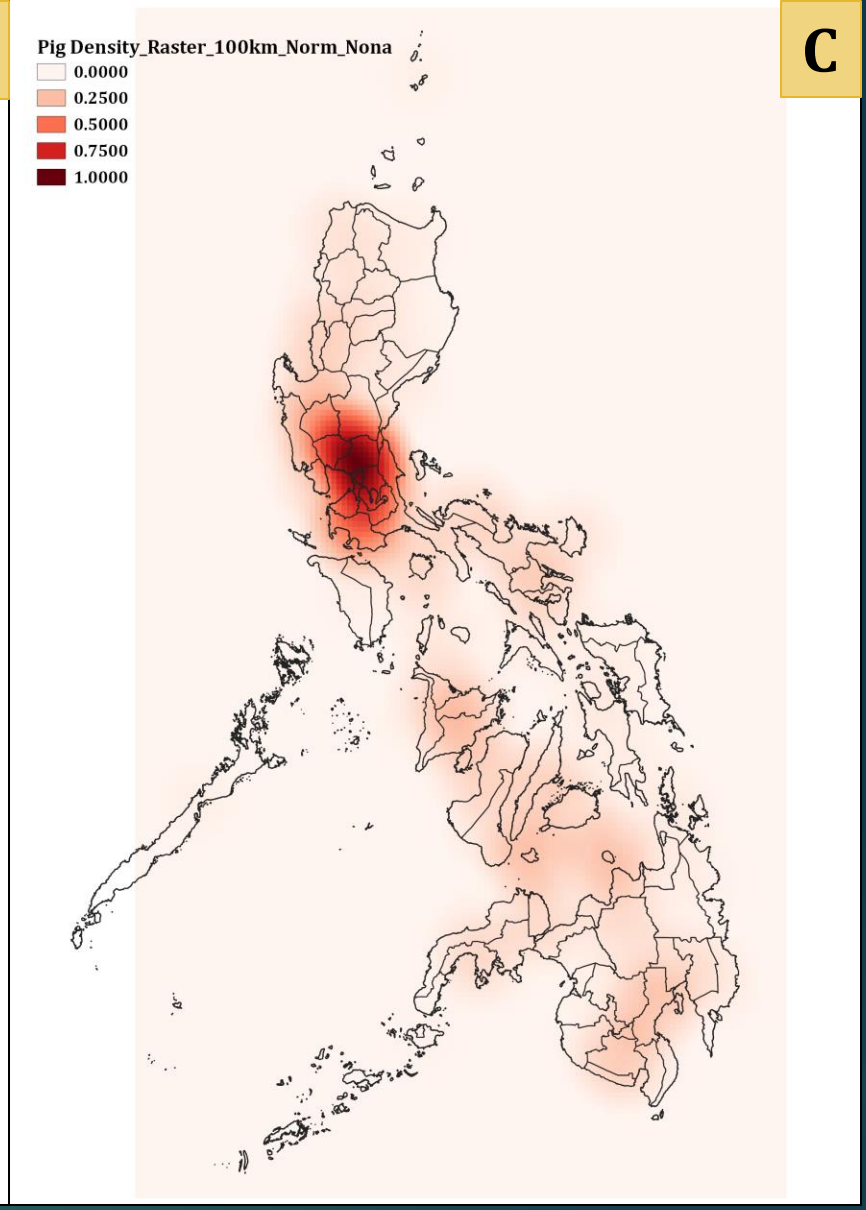
		Risk Factor 2				
		Pig population density	Location of Entry Points (Airports, seaports)	Accesibility to Roads (primary, secondary)	Location of Landfills	Provinces practicing commercial swill feeding
Risk Factor 1	Pig population density	0	-6	-6	-6	-6
	Location of Entry Points (Airports, seaports)	6	0	-3	-5	-4
	Accesibility to Roads (primary, secondary)	6	3	0	-4	-4
	Location of Landfills	6	5	4	0	-4
	Provinces practicing commercial swill feeding	6	4	4	4	0

Final Weight of Each Risk Factor for Spatial Risk Layer

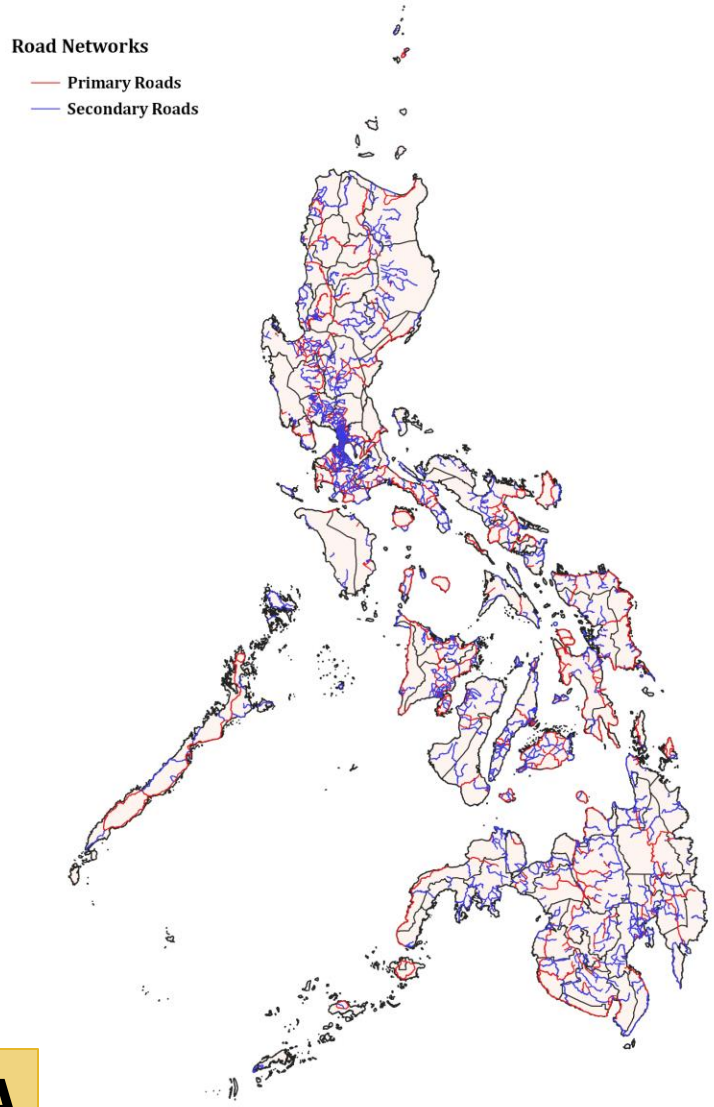
		Risk Factor 2						
		Pig population density	Location of Entry Points (Airports, seaports)	Accesibility to Roads (primary, secondary)	Location of Landfills	Provinces practicing commercial swill feeding	Geometric row mean	Weight for spatial risk layer
Risk factor 1	Pig population density	1.00	0.16	0.16	0.16	0.16	0.04	**0.00**
	Location of Entry Points (Airports, seaports)	6.09	1.00	0.41	0.22	0.30	0.46	**0.03**
	Accesibility to Roads (primary, secondary)	6.09	2.47	1.00	0.30	0.30	1.14	**0.07**
	Location of Landfills	6.09	4.50	3.33	1.00	0.30	4.21	**0.26**
	Provinces practicing commercial swill feeding	6.09	3.33	3.33	3.33	1.00	10.52	**0.64**
								1.00



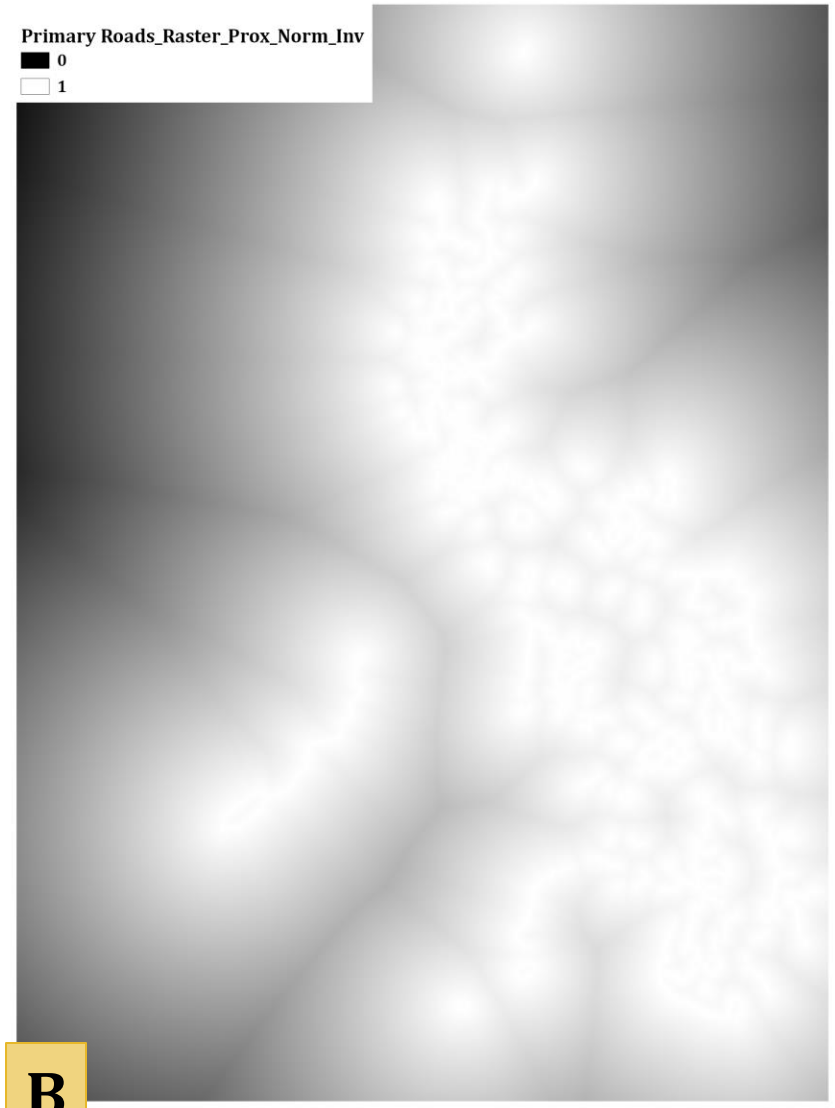




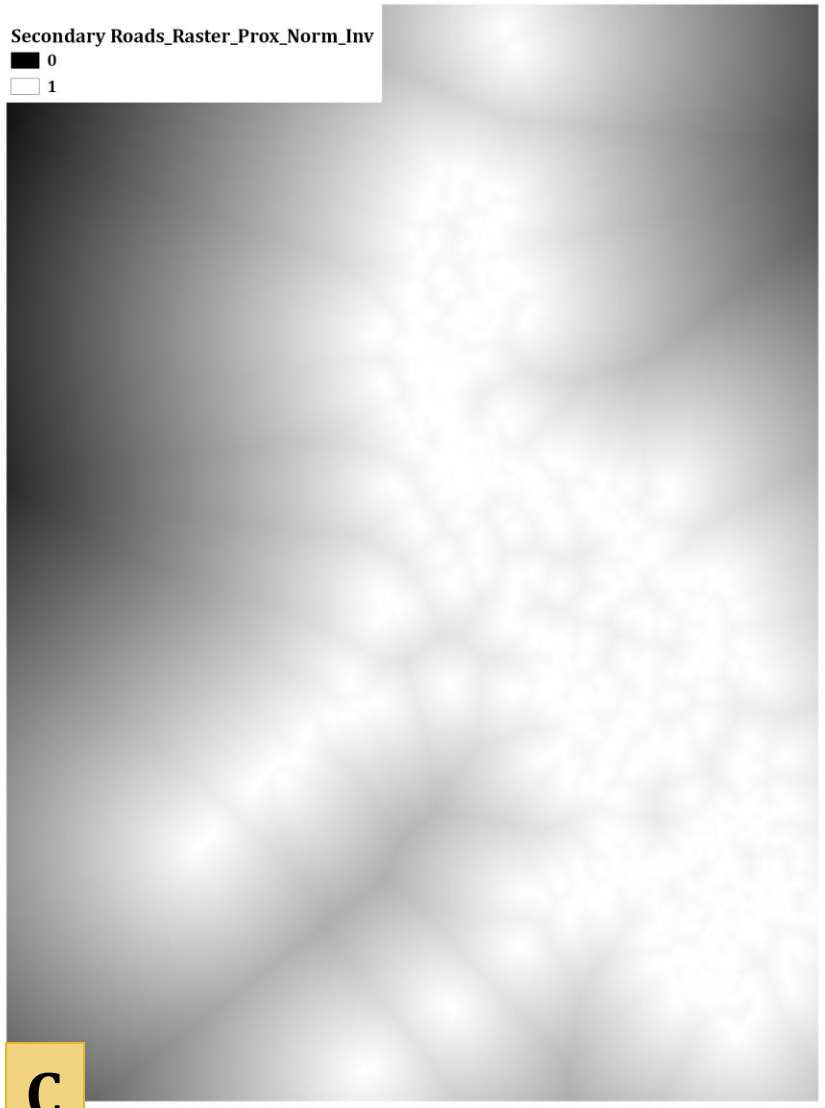
A. Choropleth Map of Pig Density (sq. km) in July 2019 (Before reported ASF outbreak)
B. Normalise Raster Layer for Pig Density
C. Final Raster Layer for Pig Density



A

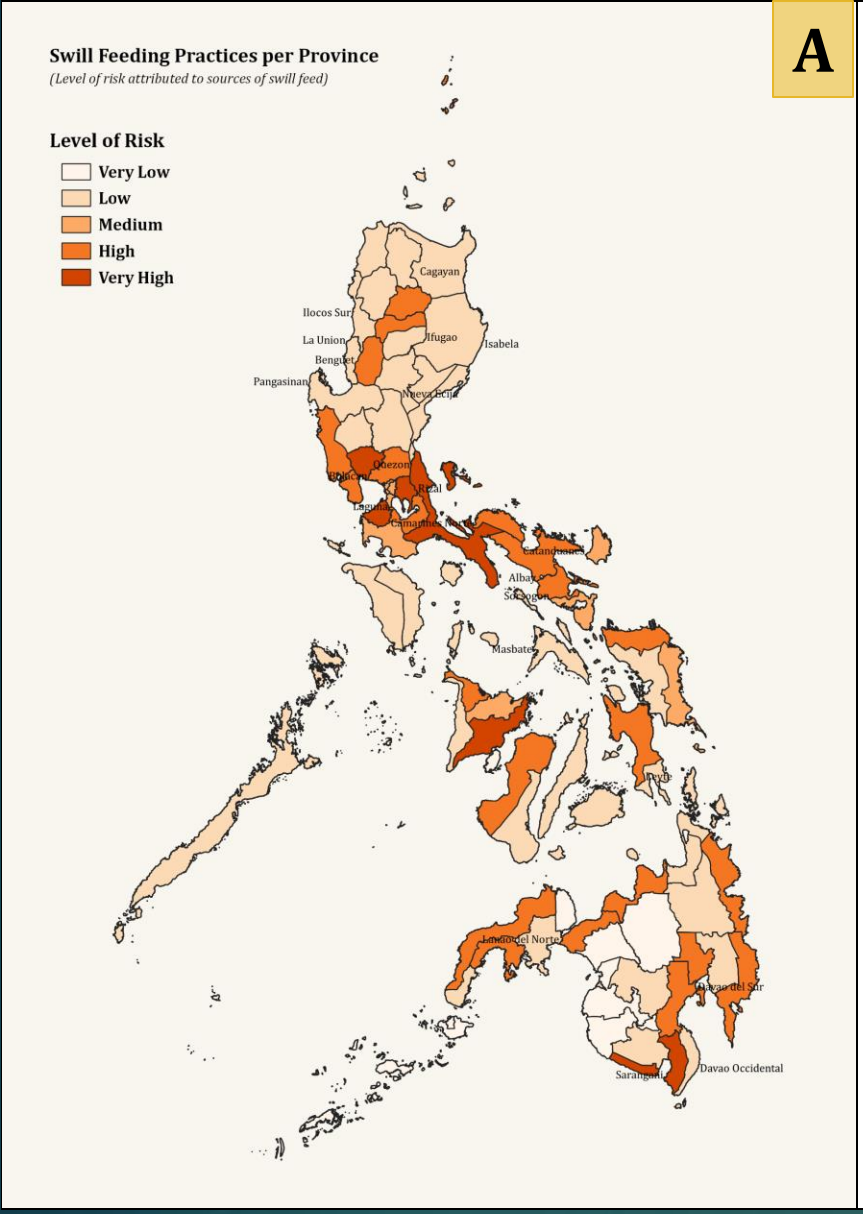


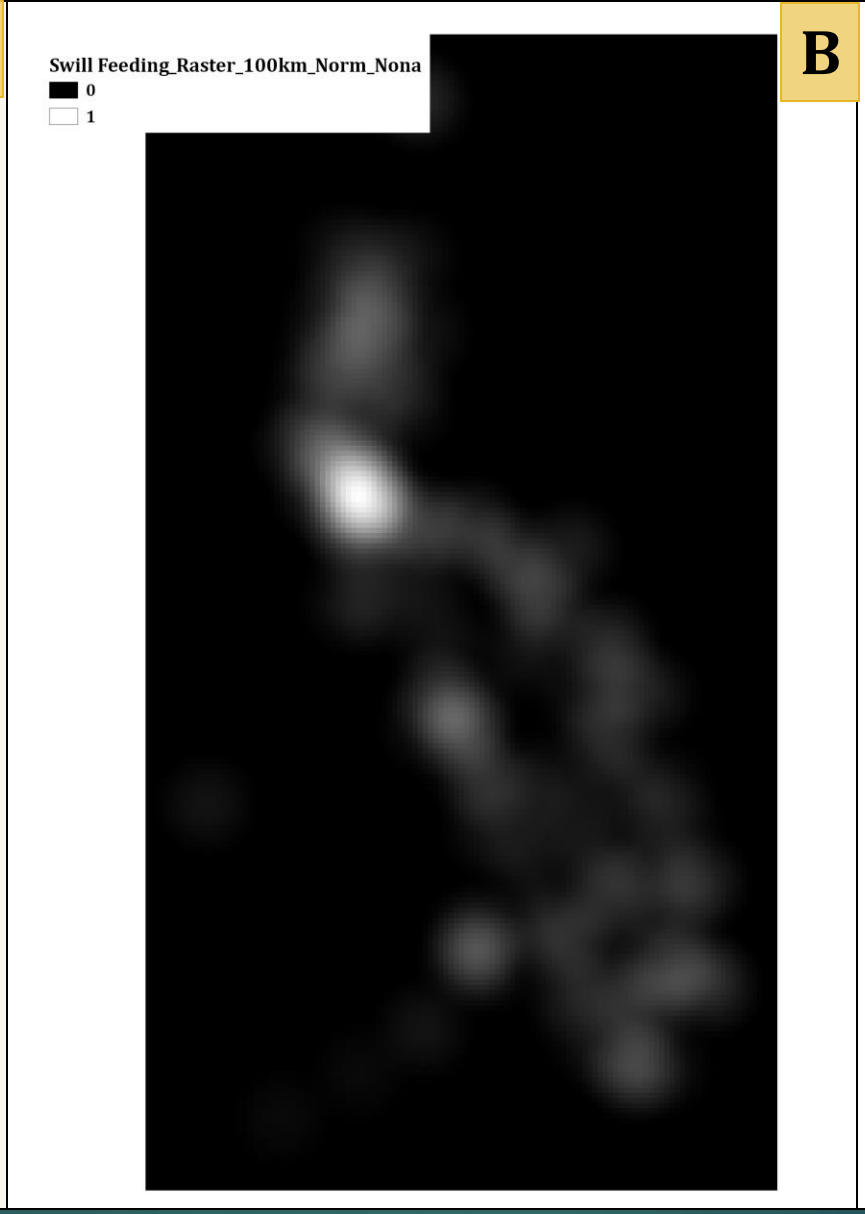
B

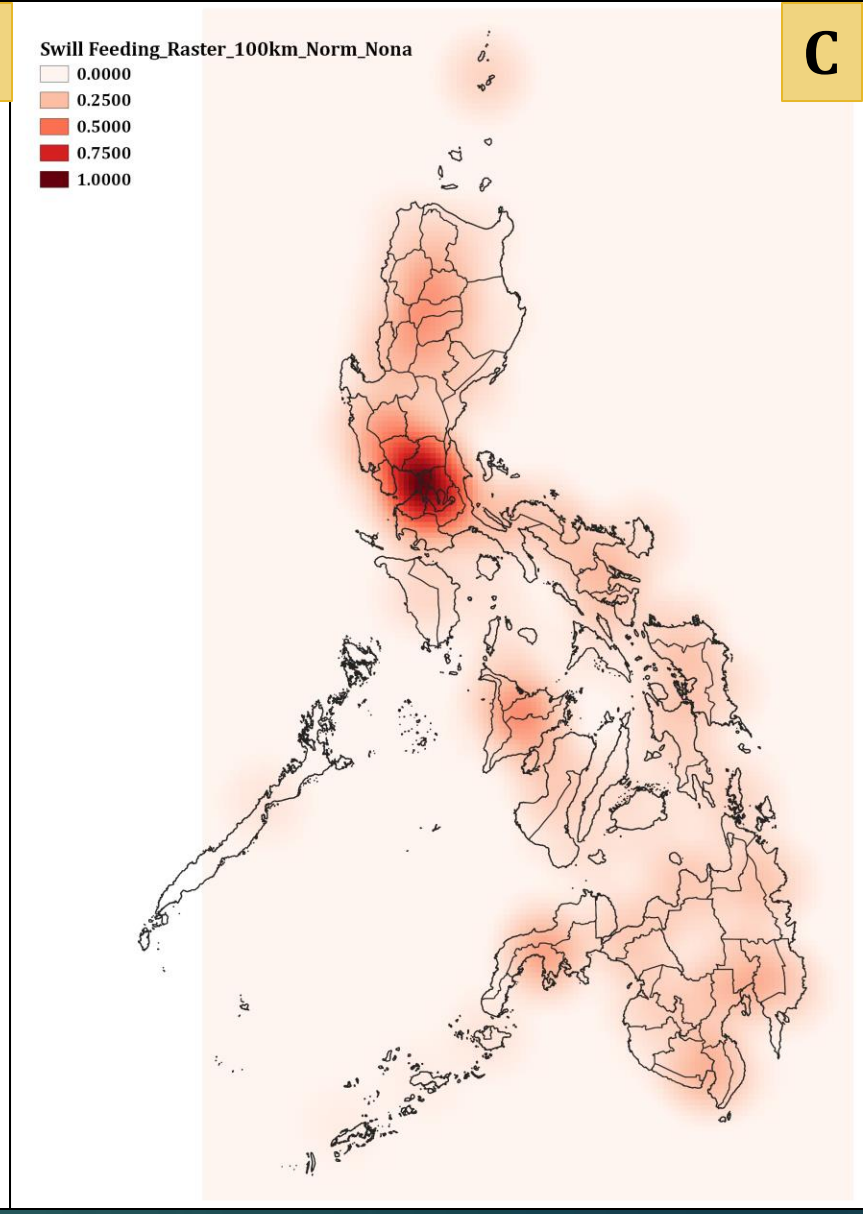


C

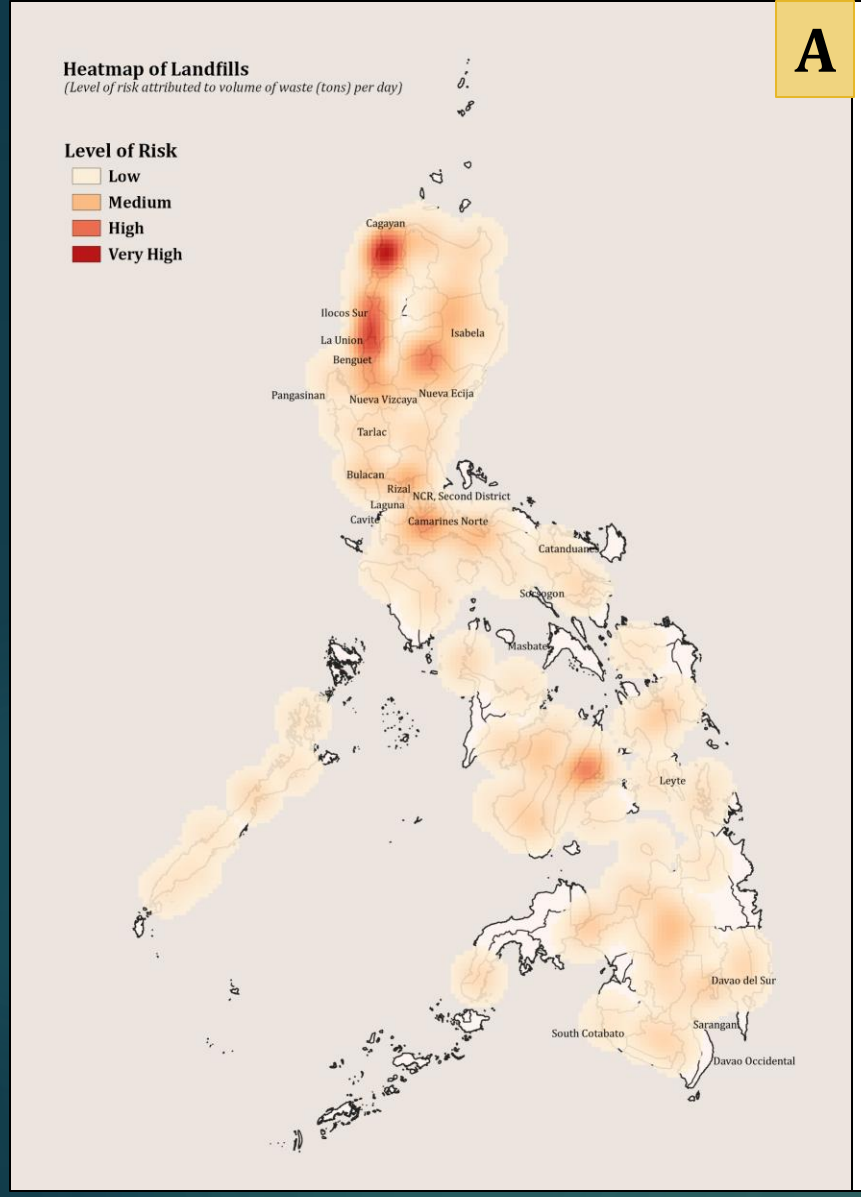
A. Road Networks Showing Primary and Secondary Roads
B. Normalise Raster Layer for Primary Roads
C. Normalise Raster Layer for Secondary Roads

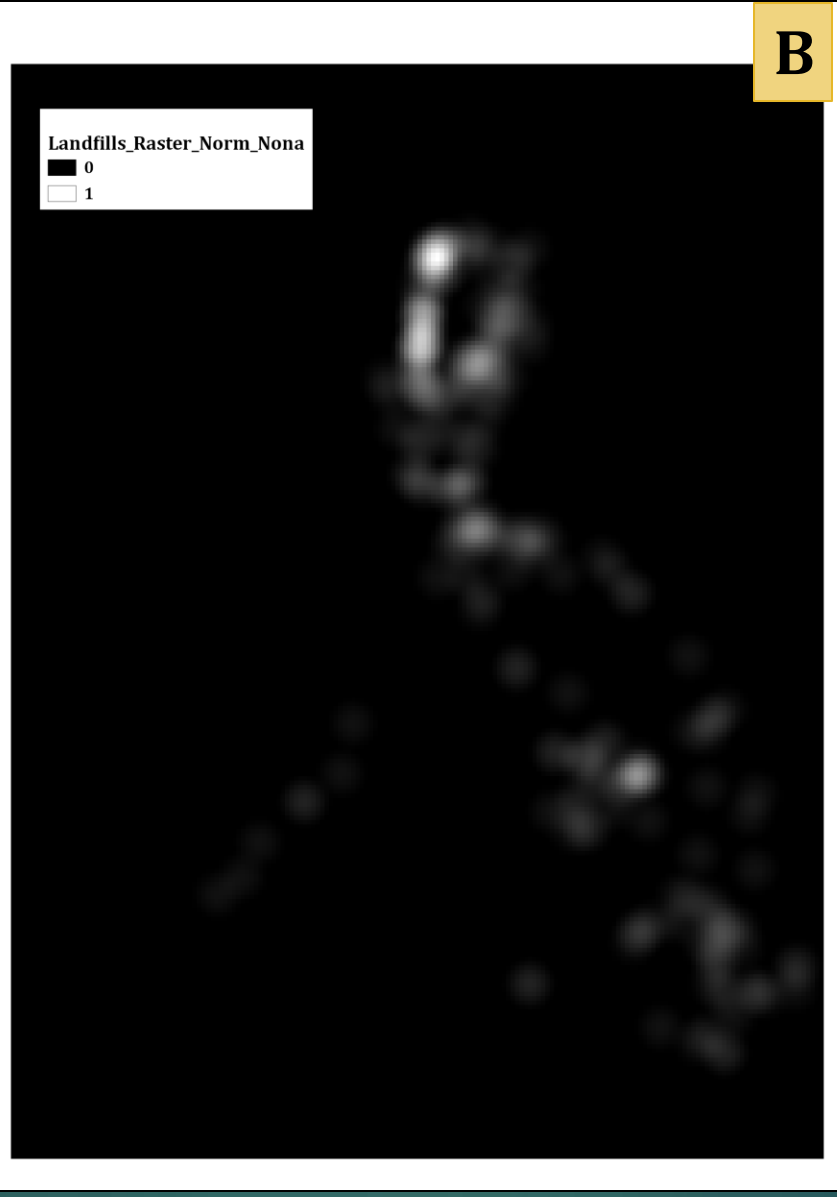


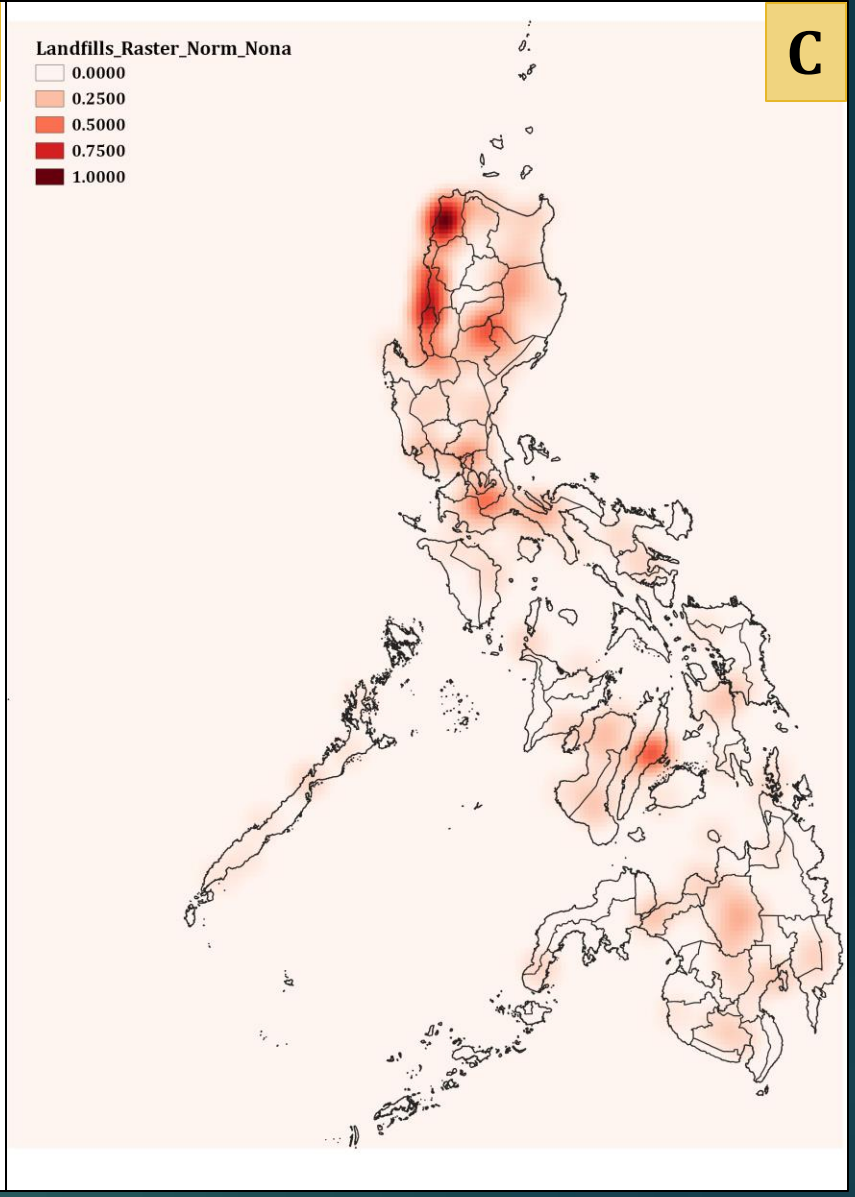




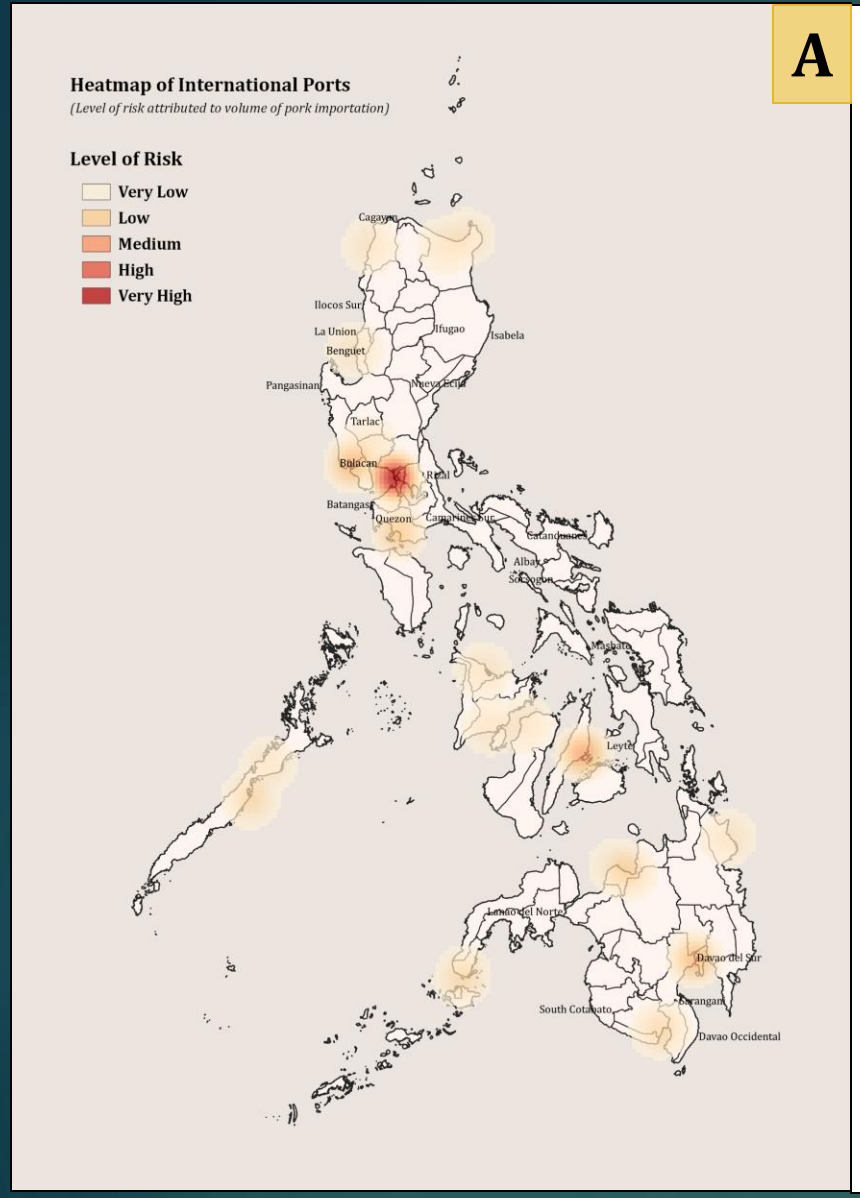
A. Choropleth Map of Swill Feeding Practices per Province
B. Normalise Raster Layer for Swill Feeding
C. Final Raster Layer for Swill Feeding

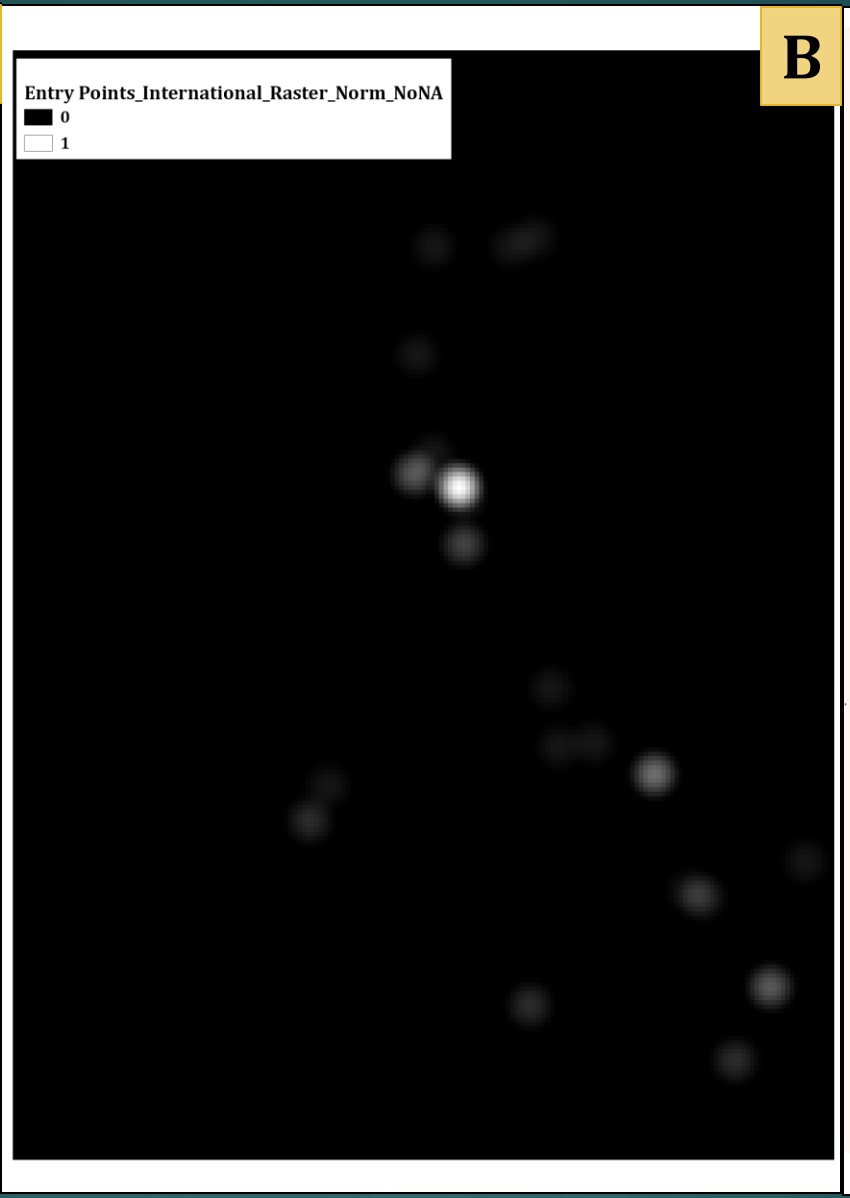


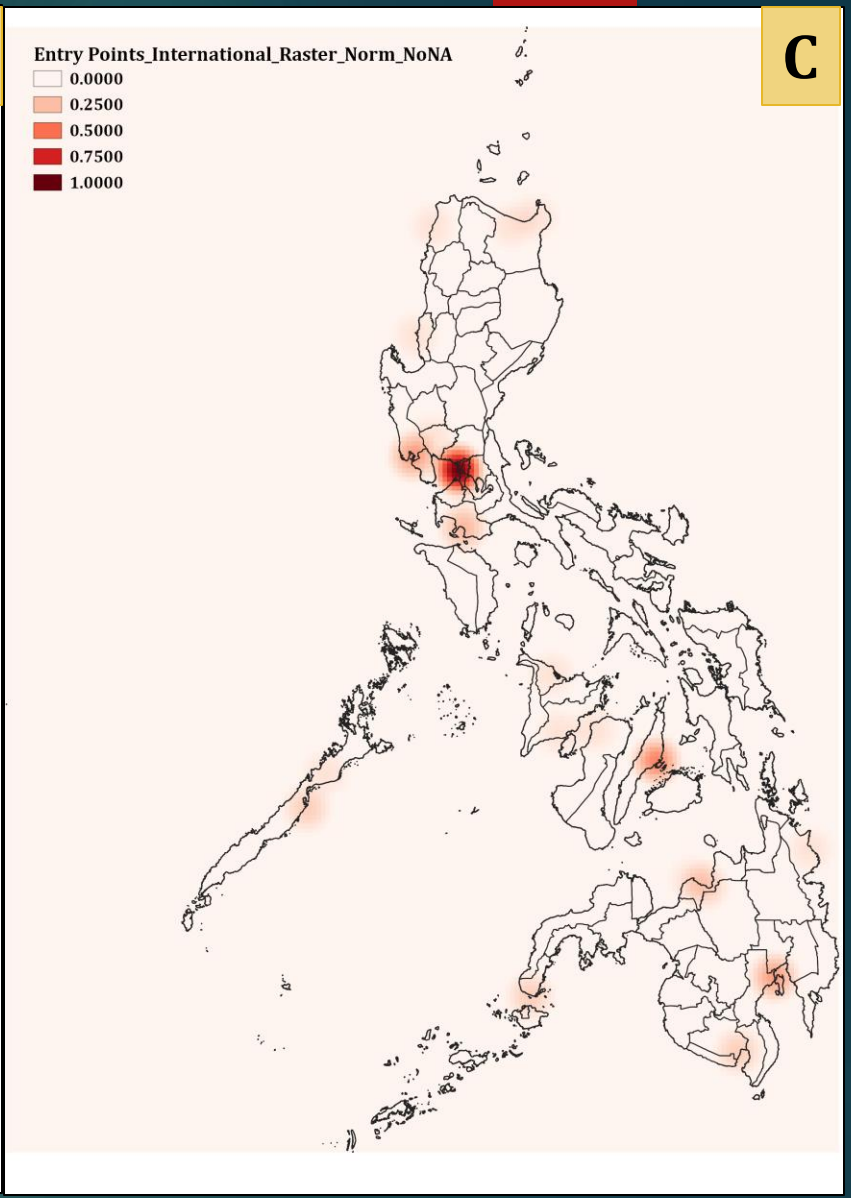




A. Heatmap of Landfills at 30km radius
B. Normalise Raster Layer for Landfills
C. Final Raster Layer for Landfills

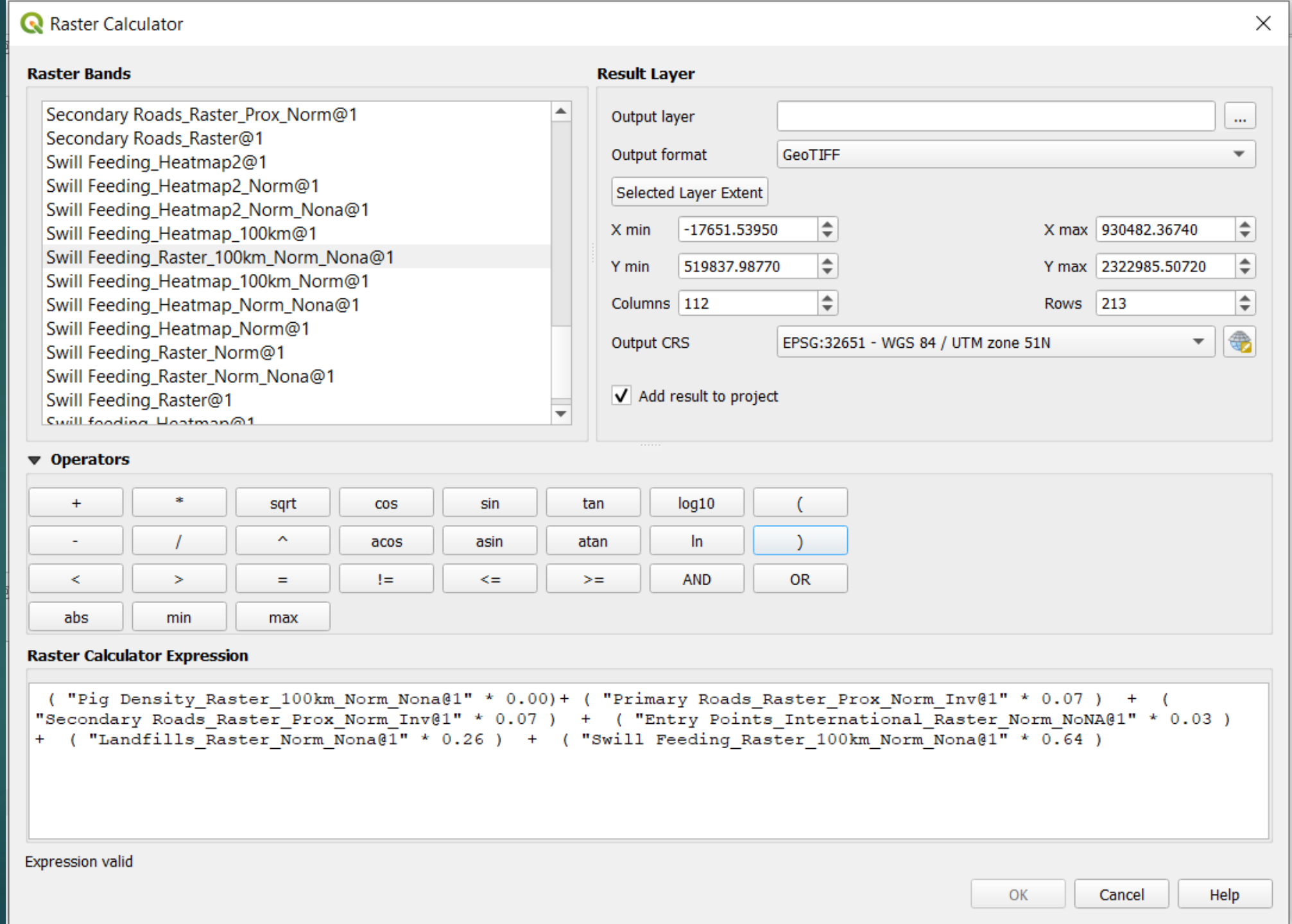




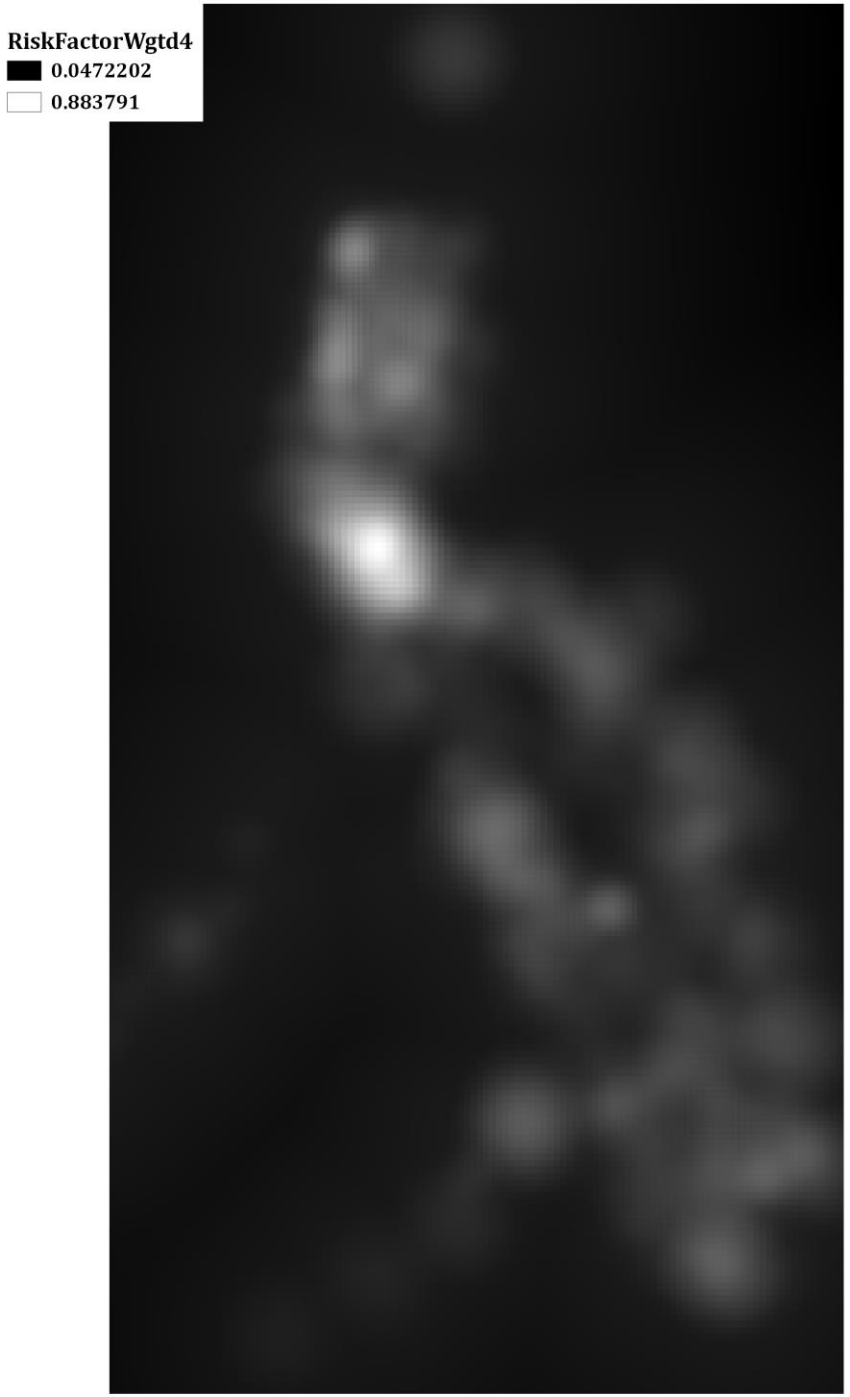


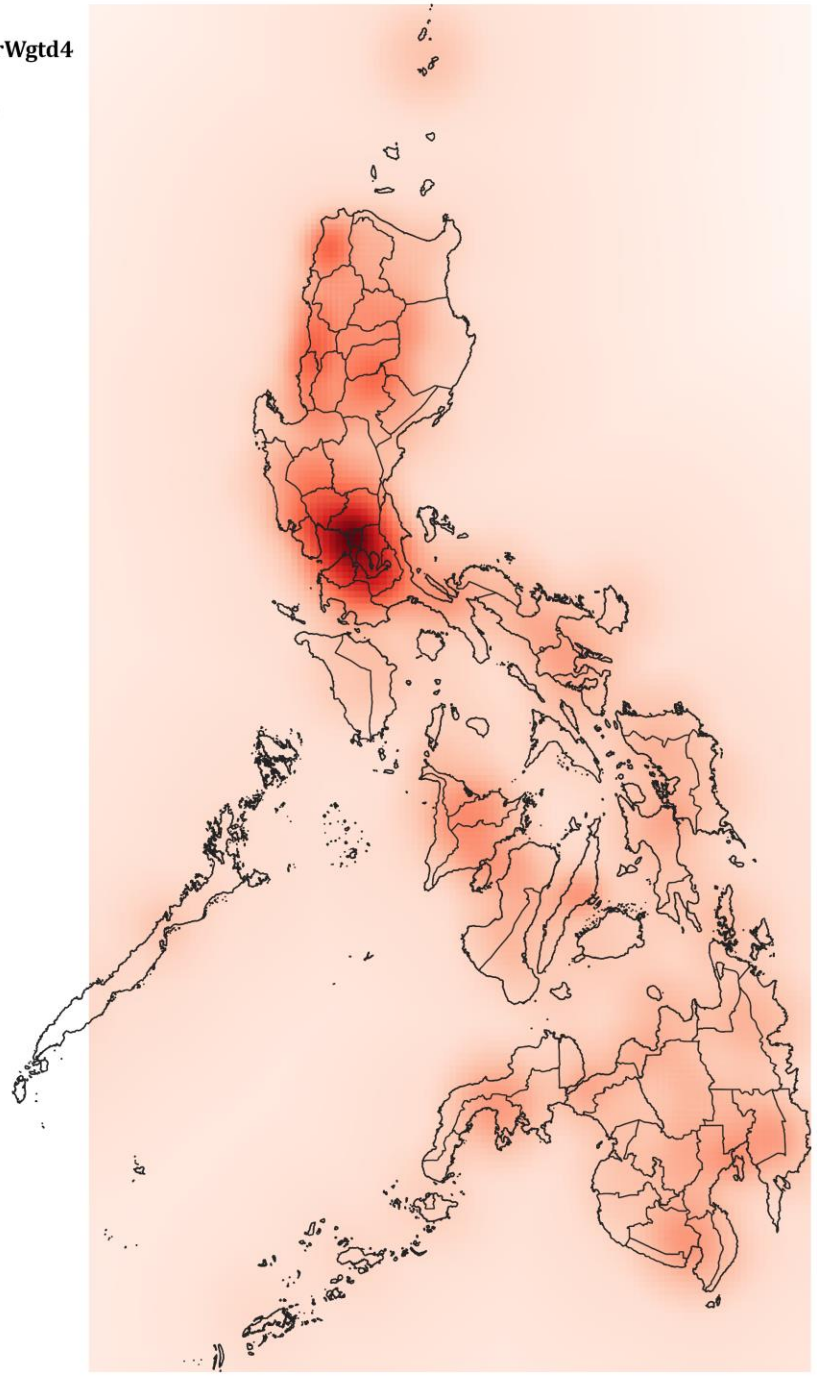
A. Heatmap of Entry Points at 50km radius
B. Normalise Raster Layer for Entry Points
C. Final Raster Layer for Entry Points

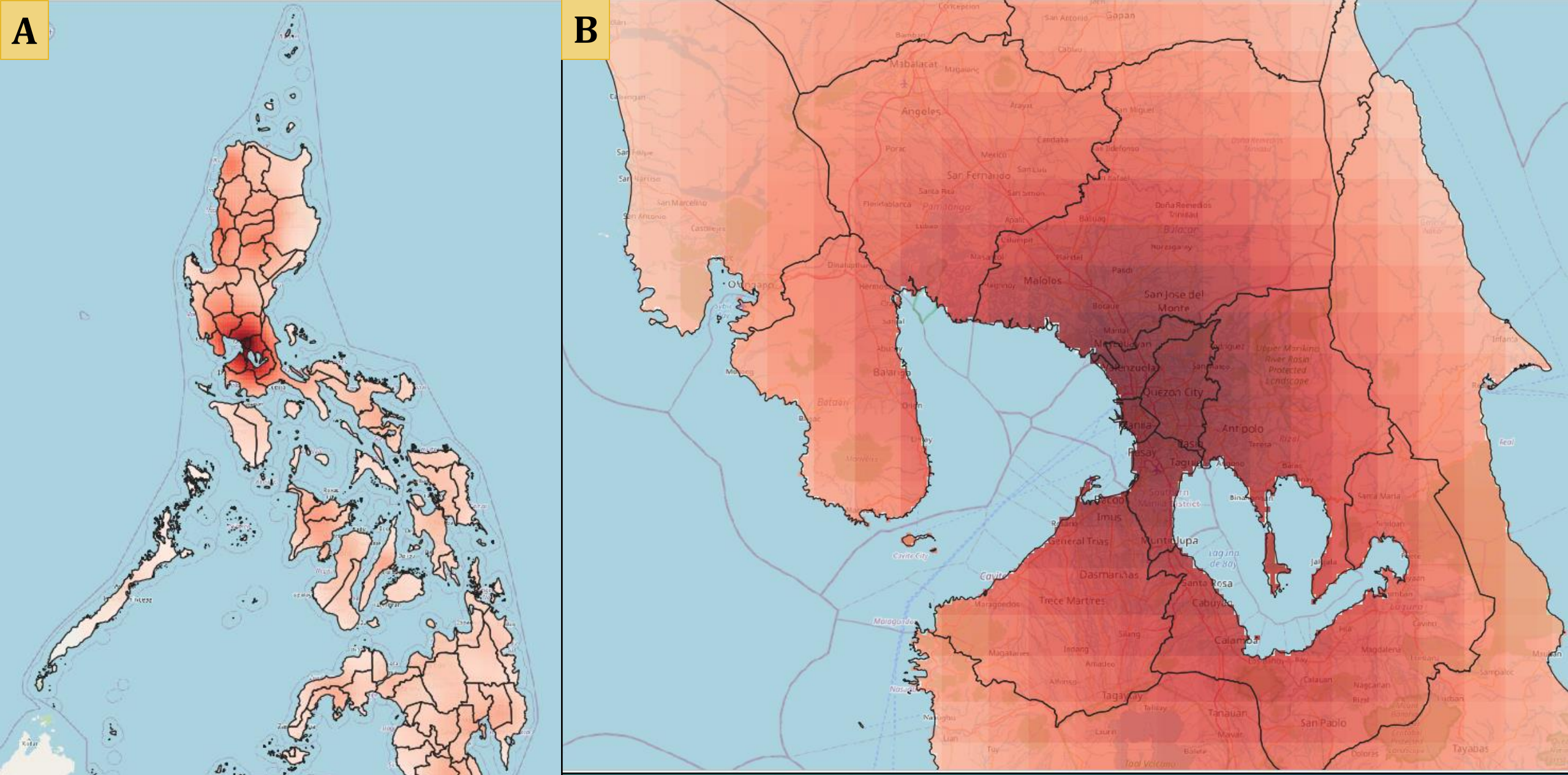
Applying MCDA Weights to each Final Risk Factor Layers to create a FINAL Raster Layer



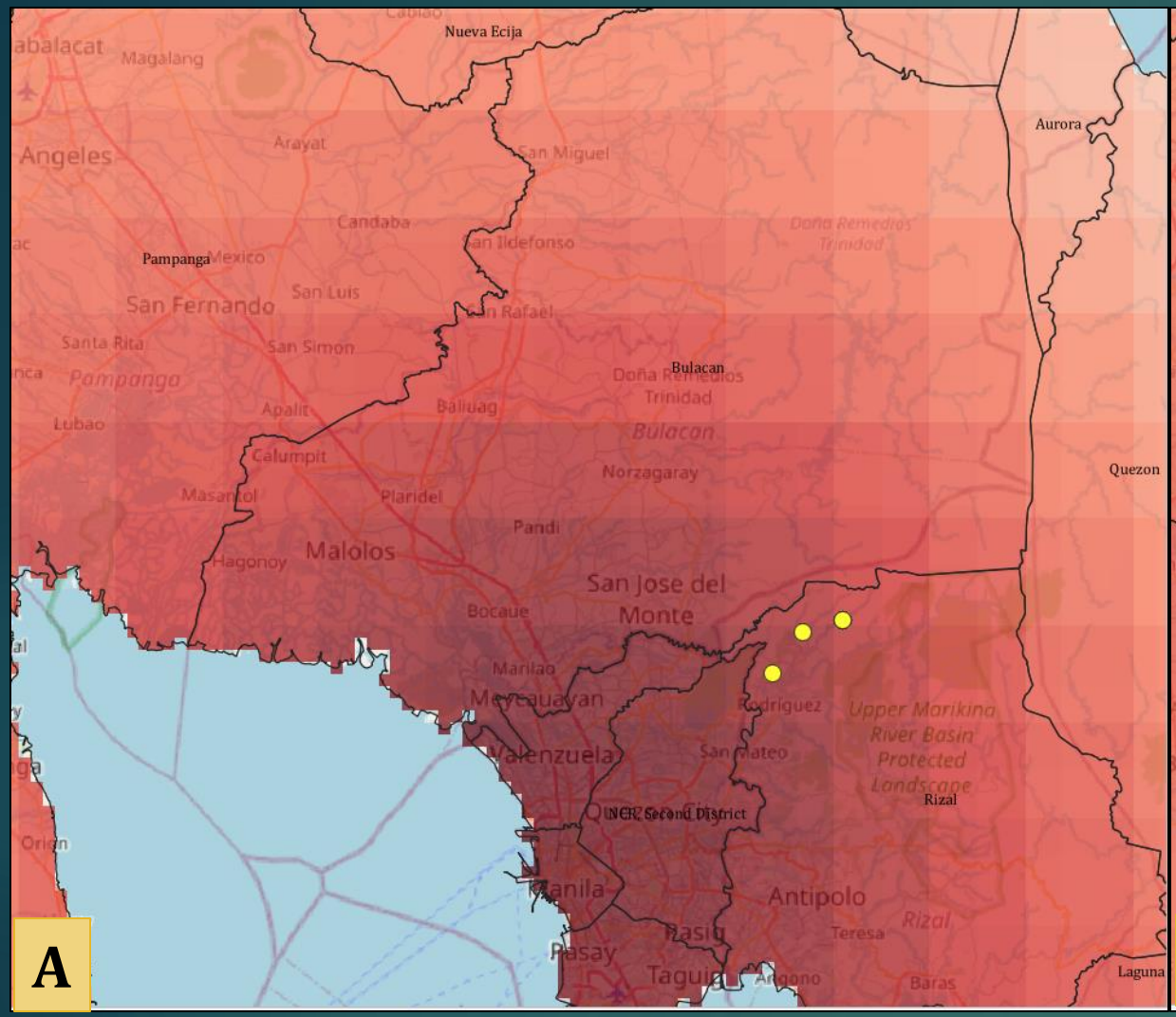
Weighted Risk Layers

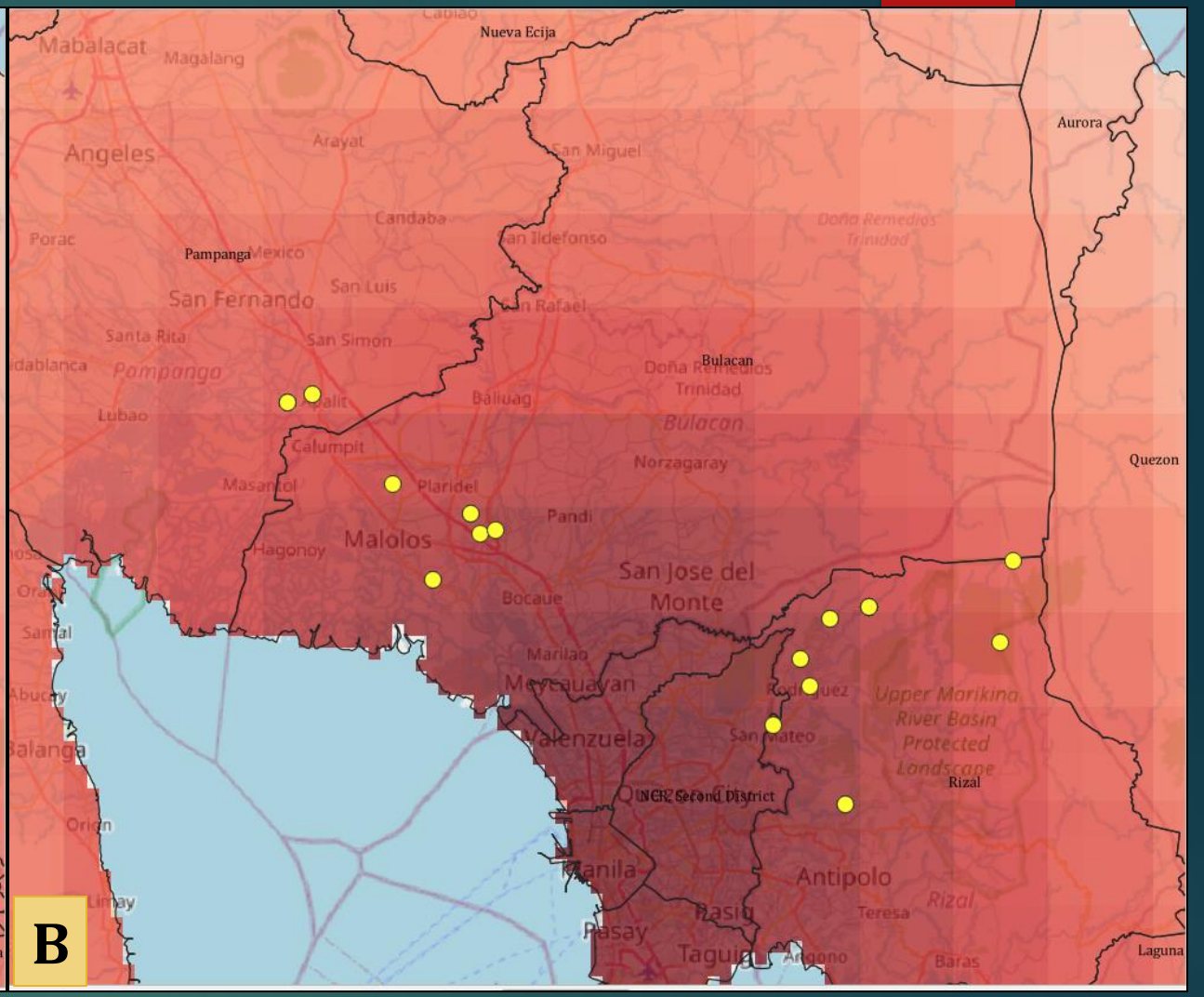






A. Risk Map of ASF Incursion in the Philippines
B. Showing Provinces identified as High Risk Areas for Incursion of ASF.



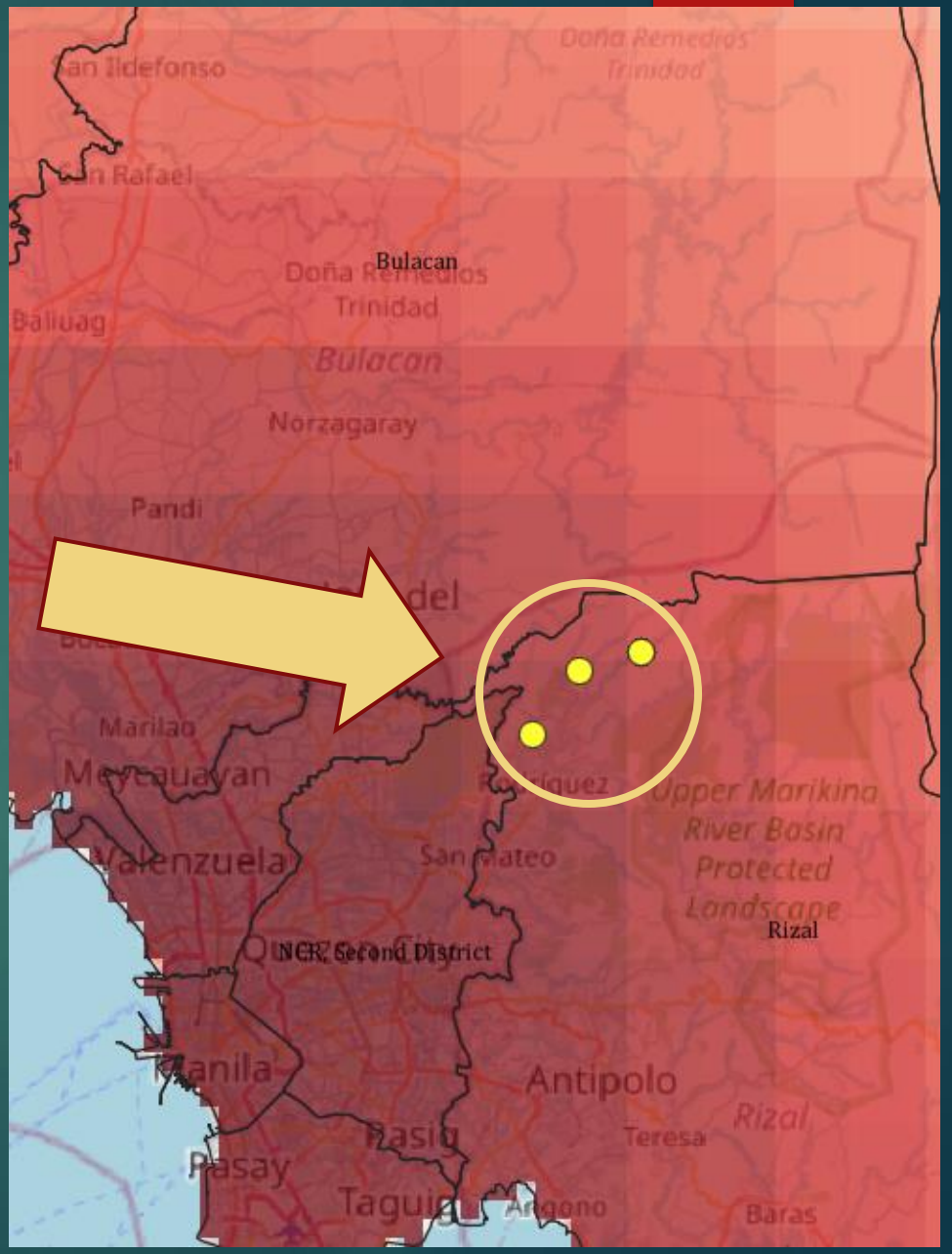


A. July 2019 – Showing centroid of the three (3) villages in Rodriguez, Rizal where ASF was first reported.

B. August 2019 –ASF cases has spread in nearby towns (Antipolo City & San Mateo, Rizal) and Provinces (Bulacan and Pampanga).

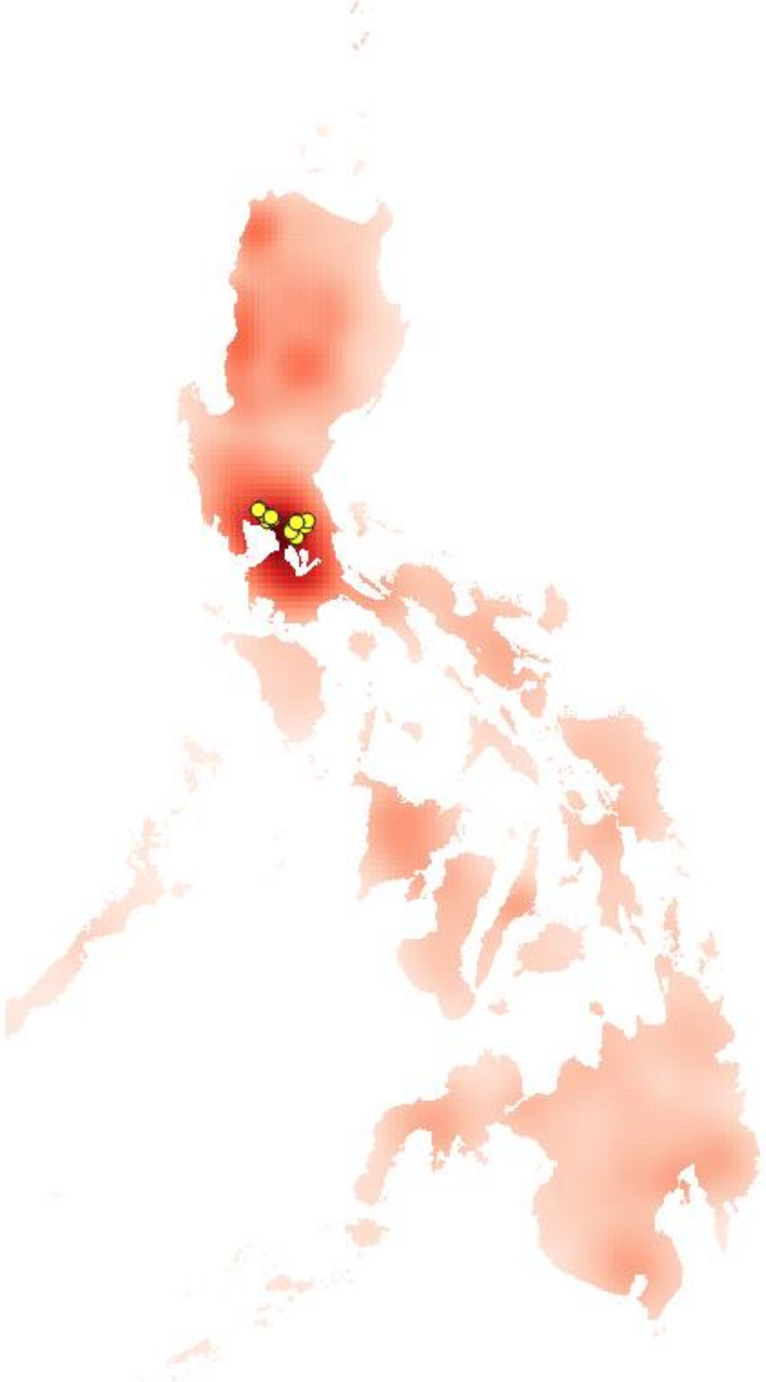
Entry and Initial Spread of ASF

SWILL



Discussion

- Among the five (5) risk factors listed, SWILL FEEDING practices had the highest weight (0.64) based on the MCDA method.
- In the 2016 swine inventory out of 12.7 million swine, **65%** were produced by backyard or smallholder producers, some of which are still practicing swill feeding based on the survey conducted among 81 provinces.
- Landfill (0.26) – where international/local food waste are dumped
- Accessibility to roads (0.07) - linked to movement of animals/animal products/feeds
- Location of airports and seaports (0.03) - serve as the probable entry points of ASF contaminated materials
- Pig Population Density (0.00)



Day	Month	Year	Region	Province	Municipali	Barangay	Lat_Cent	Long_Cent	No. of Positive Samples	SAMPLE_1		
19	August	2019	III	Bulacan	Guiguinto	Pritil	14.848949	120.885315	20	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	1	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	1	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	2	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Jose	14.754094	121.139528	2	1		
29	July	2019	IV-A	Rizal	Rodriguez	Macabud	14.785475	121.163353	1	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	2	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	3	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	3	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	1	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	1	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	1	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	1	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	1	1		
29	July	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	3	1		
21	August	2019	IV-A	Rizal	Antipolo City	Cupang	14.64257	121.176542	1	1		
21	August	2019	IV-A	Rizal	Antipolo City	Cupang	14.64257	121.176542	1	1		
21	August	2019	IV-A	Rizal	Antipolo City	Cupang	14.64257	121.176542	1	1		
21	August	2019	IV-A	Rizal	Antipolo City	Cupang	14.64257	121.176542	1	1		
21	August	2019	IV-A	Rizal	Antipolo City	Cupang	14.64257	121.176542	1	1		
22	August	2019	IV-A	Rizal	Rodriguez	San Rafael	14.768147	121.298615	5	1		
22	August	2019	IV-A	Rizal	Rodriguez	Geronimo	14.73333	121.1475813	5	1		
23	August	2019	IV-A	Rizal	Rodriguez	Mascap	14.831582	121.307656	5	1		
23	August	2019	IV-A	Rizal	San Mateo	Gitnang Bayan	14.703265	121.119011	1	1		
26	August	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	10	1		
26	August	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	3	1		
26	August	2019	IV-A	Rizal	Rodriguez	San Isidro	14.795321	121.194257	5	1		
26	August	2019	III	Bulacan	Malolos City	Panasahan	14.812921	120.847411	2	1		
26	August	2019	III	Bulacan	Plaridel	Tabang	14.86451	120.877016	5	1		
26	August	2019	III	Bulacan	Malolos City	Pinasahan	14.812921	120.847411	2	1		
26	August	2019	III	Pampanga	Minalin	Lourdes	14.954747	120.750426	3	1		
26	August	2019	III	Pampanga	Minalin	San Isidro	14.948491	120.730788	3	1		
26	August	2019	III	Pampanga	Minalin	San Isidro	14.948491	120.730788	1	1		
26	August	2019	III	Bulacan	Calumpit	Buguion	14.886229	120.814858	4	1		
26	August	2019	III	Pampanga	Minalin	San Isidro	14.948491	120.730788	1	1		
26	August	2019	III	Pampanga	Minalin	San Isidro	14.948491	120.730788	2	1		
26	August	2019	III	Pampanga	Minalin	Lourdes	14.954747	120.750426	2	1		
26	August	2019	III	Pampanga	Minalin	San Isidro	14.948491	120.730788	1	1		
26	August	2019	III	Bulacan	Guiguinto	Daungan	14.851248	120.897244	12	1		
26	August	2019	III	Bulacan	Plaridel	Tabang	14.86451	120.877016	6	1		
26	August	2019	III	Bulacan	Plaridel	Tabang	14.86451	120.877016	5	1		
										41	**41**	**100%**

Validating the Risk map vs. ASF outbreaks (July-August 2019) shows 100% risk probability (ASF Outbreaks/ Cases in high risk).

ENTRY AND INITIAL SPREAD OF ASF

International Flights

Hotels and Restaurants

SWILL

Smuggled Pork or "Co-mingled" imports

International sea-vessels

RIZAL

Landfill
Swine traders
Backyard farmers
Pig/Pork traders

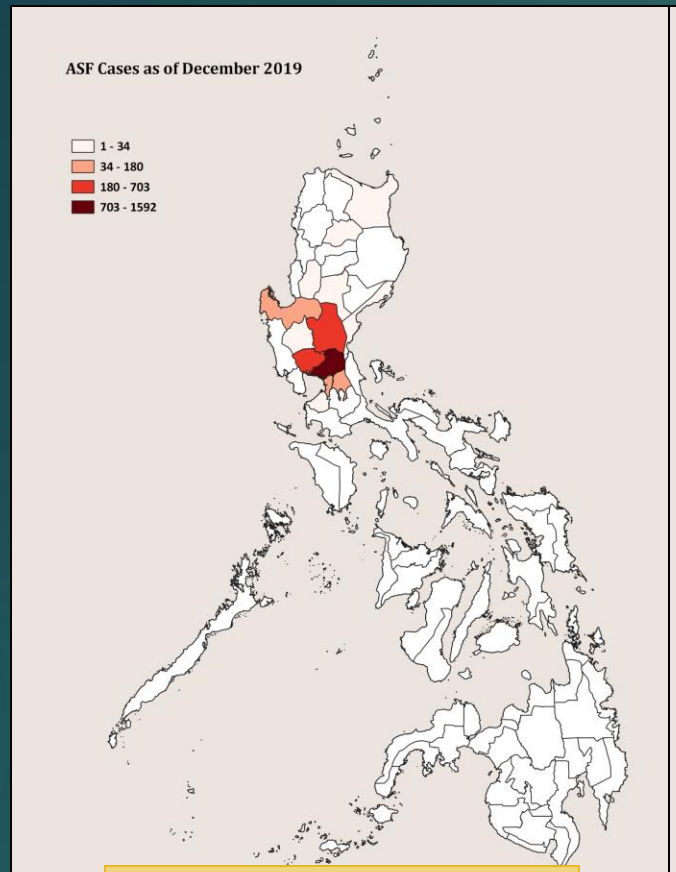
ASF Outbreak

Conclusion

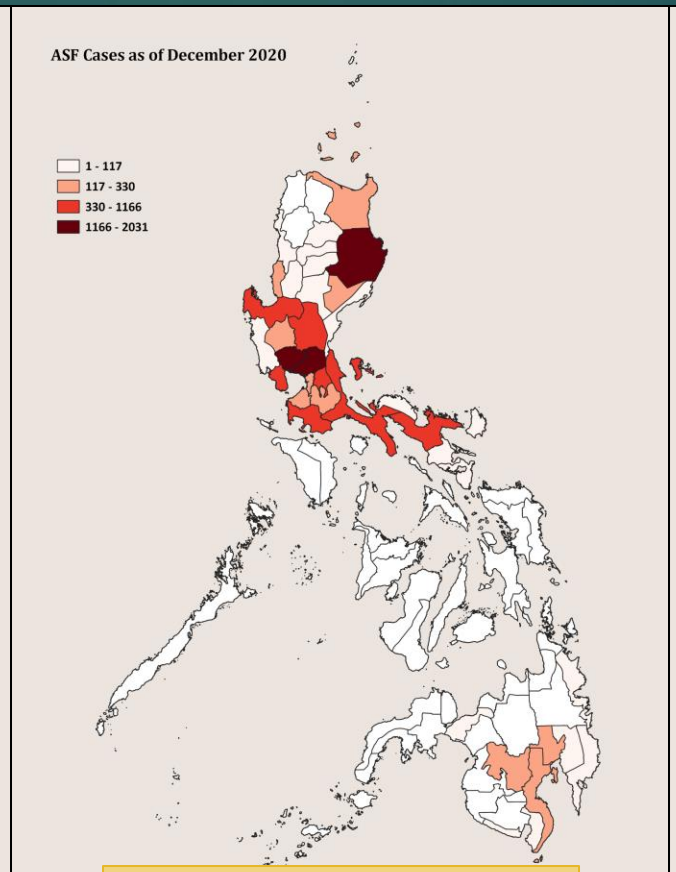
- **Findings:**
  - Swill feeding is one of the main contributors in the incursion and initial spread of ASF in the country.
  - Based on the result of the risk mapping using MCDA method, the provinces of Rizal, Pampanga, Bulacan, Laguna and Cavite are high risk areas as validated by index case of ASF outbreak in July 2019.
  - These provinces may also reflect possible high risk areas for entry of exotic/re-emerging swine diseases such as FMD.

- **Limitations:**
  - Low turnout of respondents at the municipal level for the swill feeding practices survey. Response were dependent on the insights of the Regional/Provincial Veterinarian counterparts.
  - Validation in ranking provinces practicing swill feeding.
  - Inclusion of other risk factors such as entry of contaminated meat through hand carried items brought by tourists.
  - Further classification of entry points based on volume of confiscated meat products.

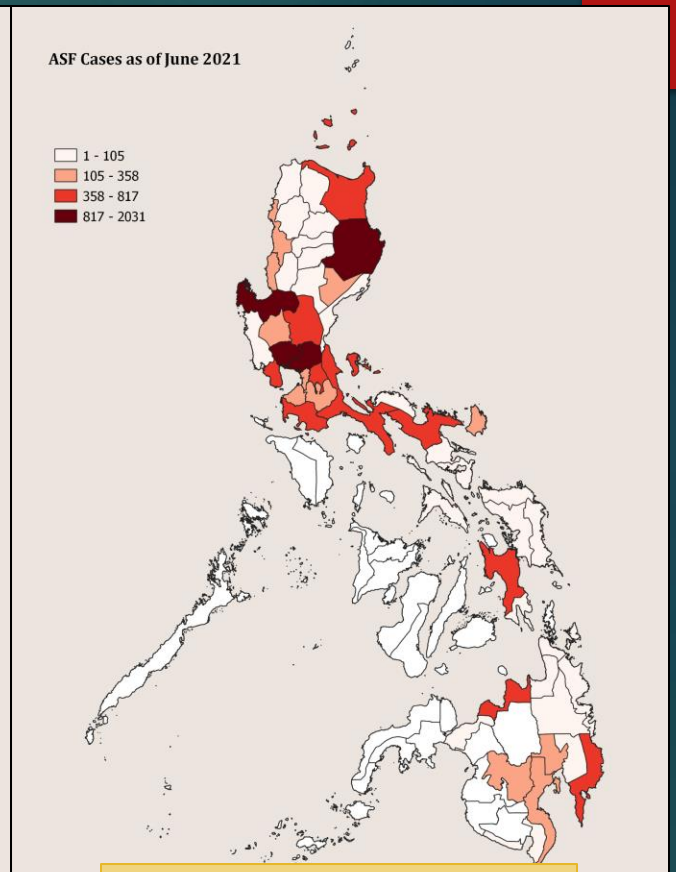
Way Forward



As of December 2019



As of December 2020



As of June 2021

- Refinement of survey method, define or categorized type of swill feed (leftovers, vegetable/crop cuttings *(binugbog)*) aside from source of swill feed as used in this SRA.
- Consideration of other risk factors for the local spread of ASF such as movement of animals/animal product between provinces, presence of veterinary quarantine checkpoints for the SRA of local spread of ASF.

Thank you!