

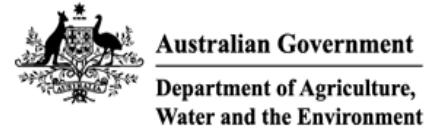
SPATIAL RISK ASSESSMENT FOR FMD RISK FACTORS OF MONGOLIA

TEAM MONGOLIA

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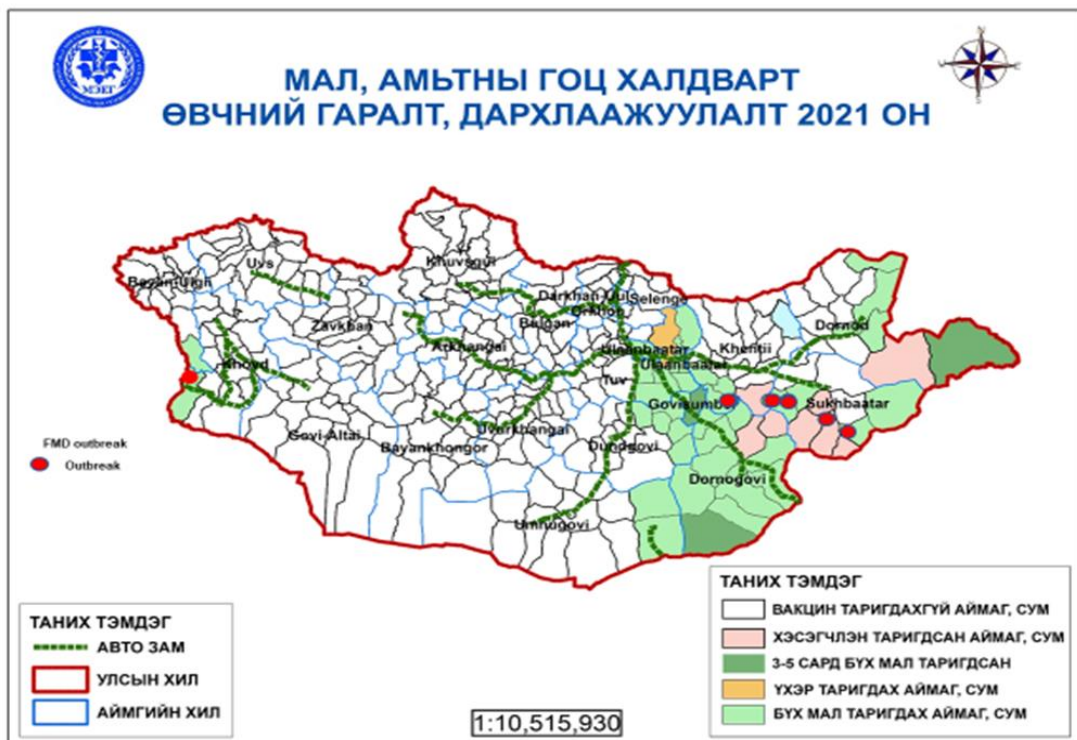


Background and Rational

FMD is one of priority diseases in Mongolia

- Outbreaks (Reoccurrence) of FMD have been reported in this years.
- Due to the high cost of FMD control and surveillance, the risk needs to be assessed and responded to in high-risk areas in the short term.
- In order to increase the economic turnover of Mongolia, we aim to support the export of raw materials and products of animal origin, including meat.

FMD outbreak currents situation in 2021



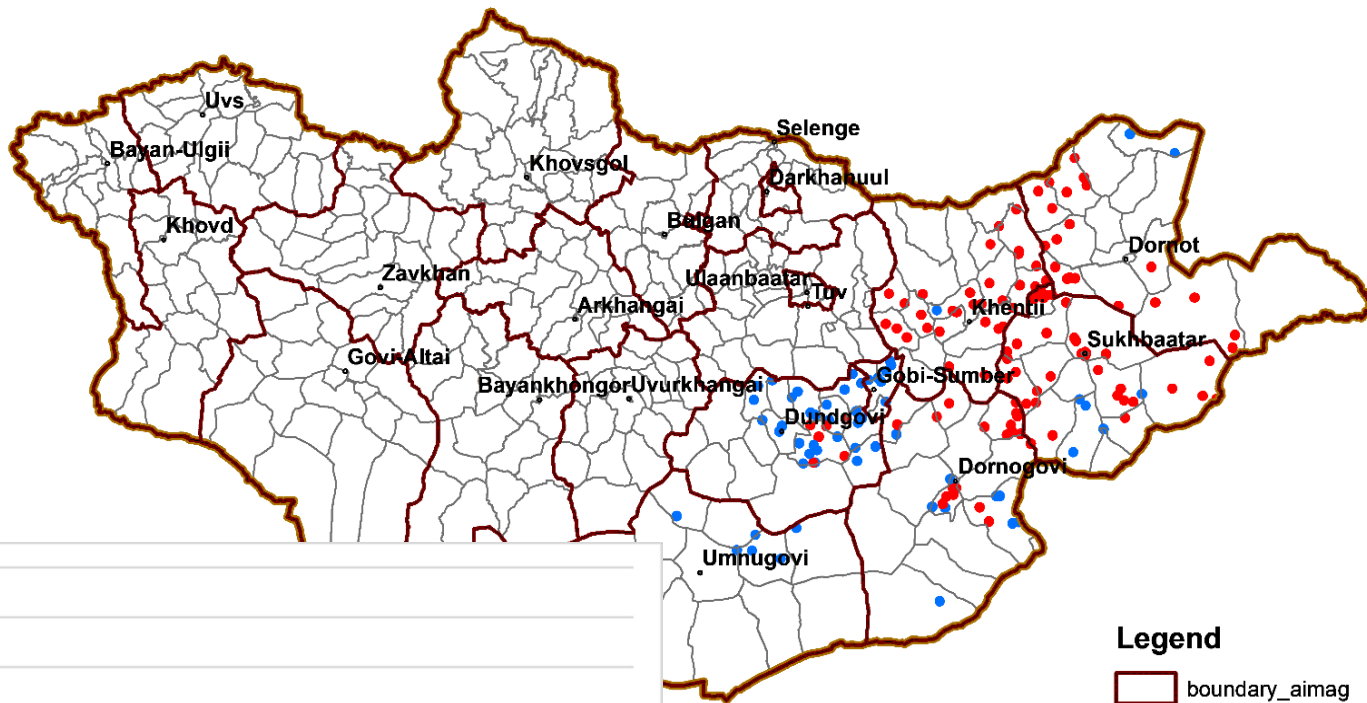
Control measures

- Emergency and routine Vaccination
- Surveillance outside containment and or the protection zone
- Movement control
- Quarantine

No	Province	Soum name	Started on	Cases /Cattle/	Sheep and goats	Status
1	Khovd	Bulgan	2021.06.30	85		on-going
2	Sukhbaatar	Ongon	2021.05.13	16		Resolved
3	Sukhbaatar	Galshar	2021.05.31		141	Resolved
4	Sukhbaatar	Tuvshinshiree	2021.06.08		8	Resolved
5	Dornogovi	Ikhet	2021.06.17		721	Resolved
6	Khentii	Darkhan	2021.06.18	38		Resolved
Total				139	870	

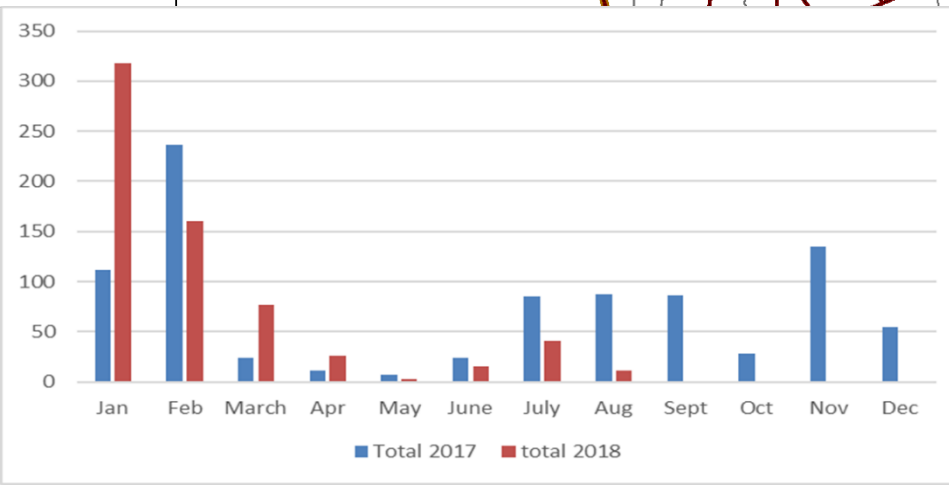
SPATIAL RISK ASSESSMENT ON FMD OUTBREAK IN MONGOLIA -2018

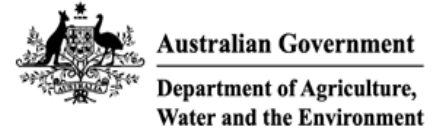
FMD cases in Mongolia from 2017 to 2018



Legend

- boundary_aimag
- boundary_country
- boundary_soums
- 1 Dot = 1
- FMD_2017
- FMD_2018





Methodology

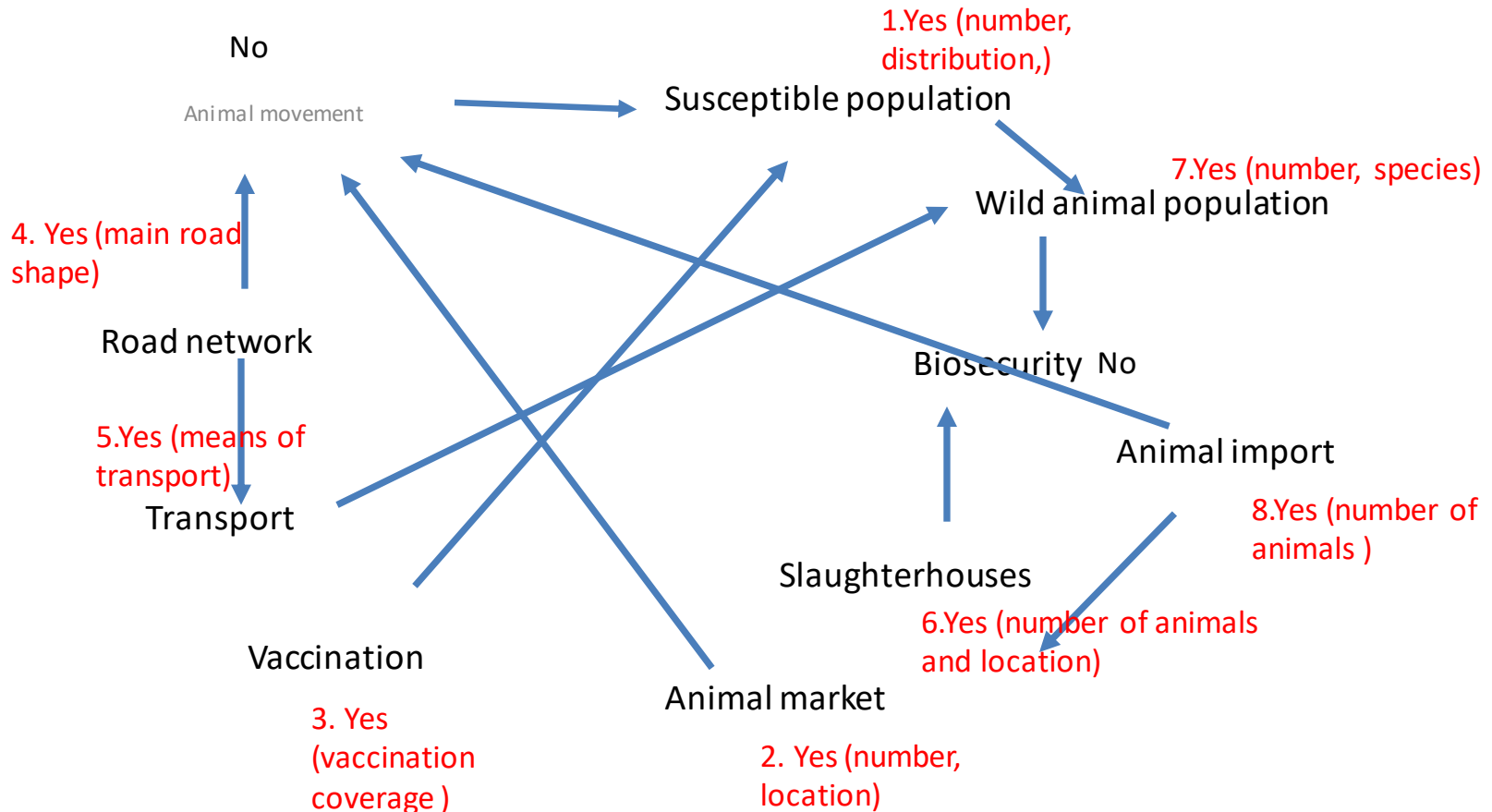
Risk factors (FMD)

```
graph TD;
    Susceptible[Susceptible population] --> Wild[Wild animal population];
    Wild --> Biosecurity[Biosecurity];
    Biosecurity --> AnimalImport[Animal import];
    AnimalImport --> Slaughterhouses[Slaughterhouses];
    Slaughterhouses --> AnimalMarket[Animal market];
    AnimalMarket --> Vaccination[Vaccination];
    Vaccination --> Transport[Transport];
    Transport --> RoadNetwork[Road network];
    RoadNetwork --> AnimalMovement[Animal movement];
    AnimalMovement --> Susceptible;
    AnimalMarket --> Wild;
    Wild --> Biosecurity;
    Biosecurity --> AnimalImport;
    AnimalImport --> Slaughterhouses;
    Slaughterhouses --> AnimalMarket;
    AnimalMarket --> Vaccination;
    Vaccination --> Transport;
    Transport --> RoadNetwork;
    RoadNetwork --> AnimalMovement;
    AnimalMovement --> Susceptible;
```

The diagram illustrates a complex network of relationships between various factors in a disease control model. The nodes and their associated red text labels are:

- Susceptible population** (1.Yes (number, distribution,))
- Wild animal population** (7.Yes (number, species))
- Biosecurity** (No)
- Animal import** (8.Yes (number of animals))
- Slaughterhouses** (6.Yes (number of animals and location))
- Animal market** (2. Yes (number, location))
- Vaccination** (3. Yes (vaccination coverage)
- Transport** (5.Yes (means of transport))
- Road network** (4. Yes (main road shape))
- Animal movement** (No)

Arrows indicate the flow and interactions between these factors, showing a highly interconnected system where changes in one area can affect multiple others.



Questionnaire developed and circulated among experts

Collected 10 responses from FMD experts by google form questionnaire regarding to the importance of chosen risk factors

docs.google.com/forms/d/1NqG1jHwRWmv5o5thGyPbhqqfzbD2pmasRfQm5Dtjs/edit

YouTube Maps

1. What your name?

Short answer text

1. When comparing Cattle population density with National and local roads for the incursion and spread of FMD, Cattle population density is

☐ a. extremely less important

☐ b. very strongly less important

☐ c. strongly less important

☐ d. moderately less important

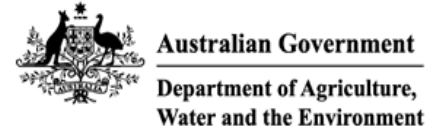
☐ e. equally important

☐ f. moderately more important

☐ g. strongly more important

☐ h. very strongly more important

1. Bolortuya.P, OIE
2. Batchuluun.D, SCVL
3. Chris Bartels, FAO
4. Gerelmaa.U, FAO
5. Amarsanaa.L, FAO
6. Battsetseg.G, FAO
7. Batkhyag.S, MOFA
8. Bodisakhan.Kh, GAVS
9. Erdeneochir.Ts, MULS
- 10.Chimedtseren.B, MULS



Results and Validation

Identified and selected risk factors

Factor Code	Factor Abbrev	Factor Description
A	WSS	Water sharing springs
B	RDS	National and local roads
C	CTL	Cattle population density
D	SRP	Small ruminants population density

Weighed risk factors

		RISK FACTOR 2					
		National and local roads	Cattle population density	Small ruminants population density	Water sharing springs	Geometric row mean	Weight for spatial risk layer
RISK FACTOR 1	National and local roads	1.00	0.55	0.74	1.35	0.77	0.18
	Cattle population density	1.83	1.00	1.00	1.35	1.48	0.35
	Small ruminants population density	1.35	1.00	1.00	1.35	1.30	0.31
	Water sharing springs	0.74	0.74	0.74	1.00	0.68	0.16
							1.00

Data sources for the Risk layers

Mongolian shapefile downloaded from *Geofabrik system*.

- Risk factor water sharing springs /Heat map/ *Figure 1*.
- Country boundary, national and local roads /Proximity/ *Figure 2*.

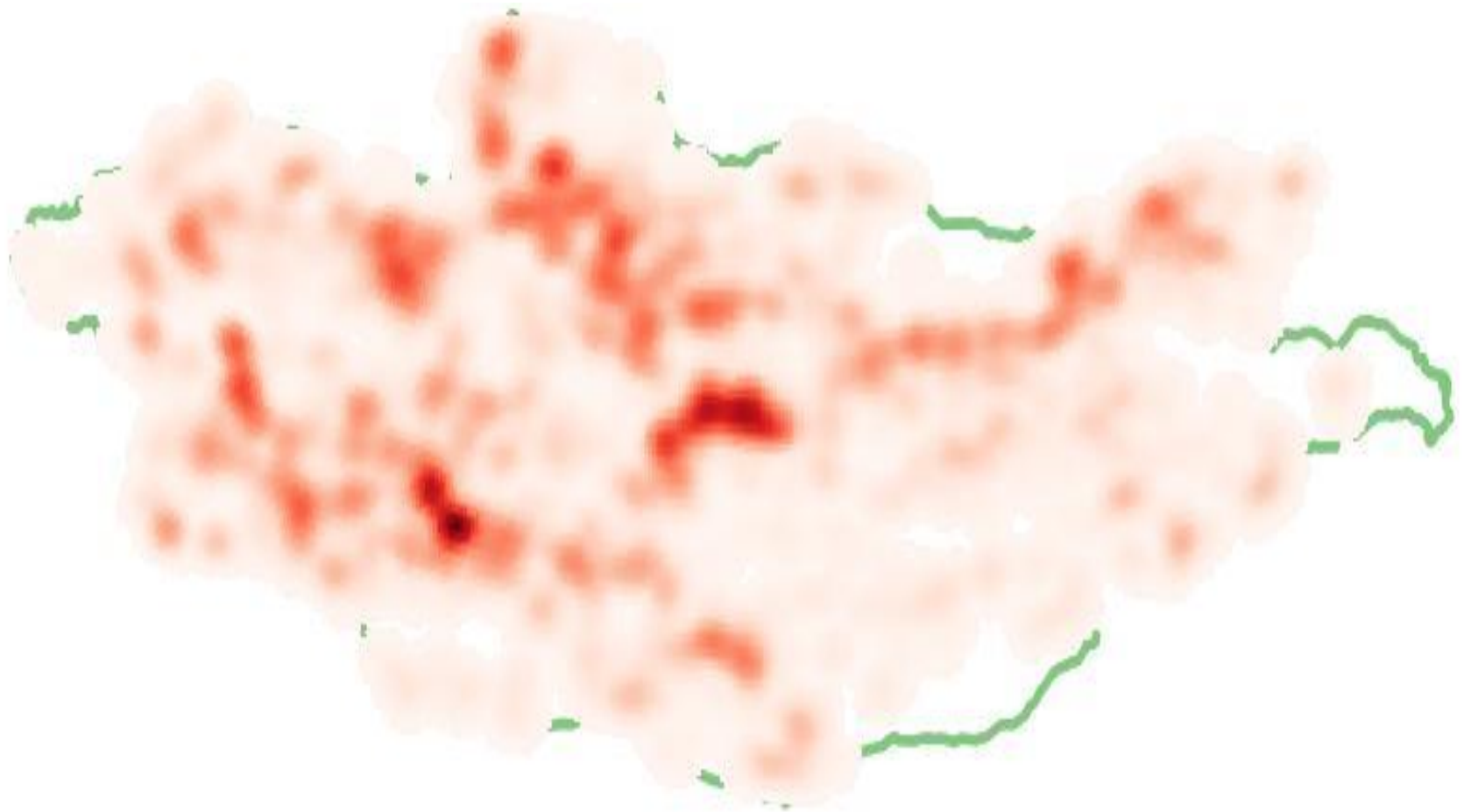
Livestock data collected from *FAO livestock system*

- Cattle and small ruminants population density /Raster/ *Figure 3*.

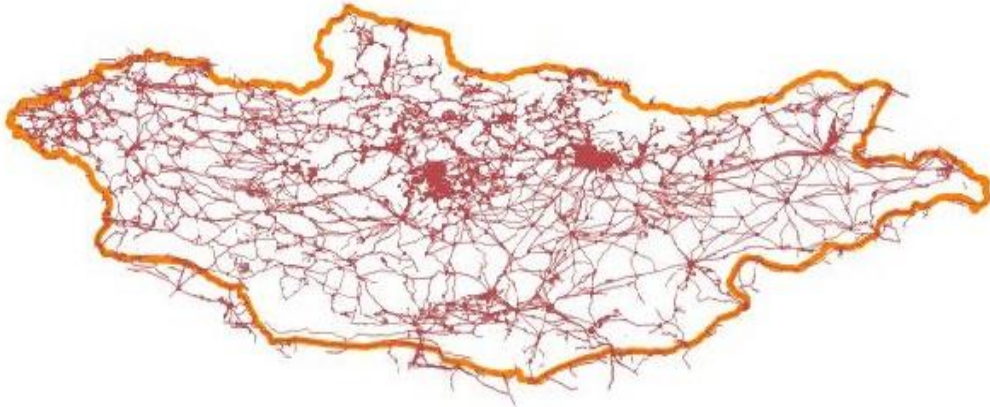
Then...

FMD outbreak locations GPS in Mongolia, 2018

Risk factor water sharing springs /Heat map/



Risk factor national and local roads /Proximity/

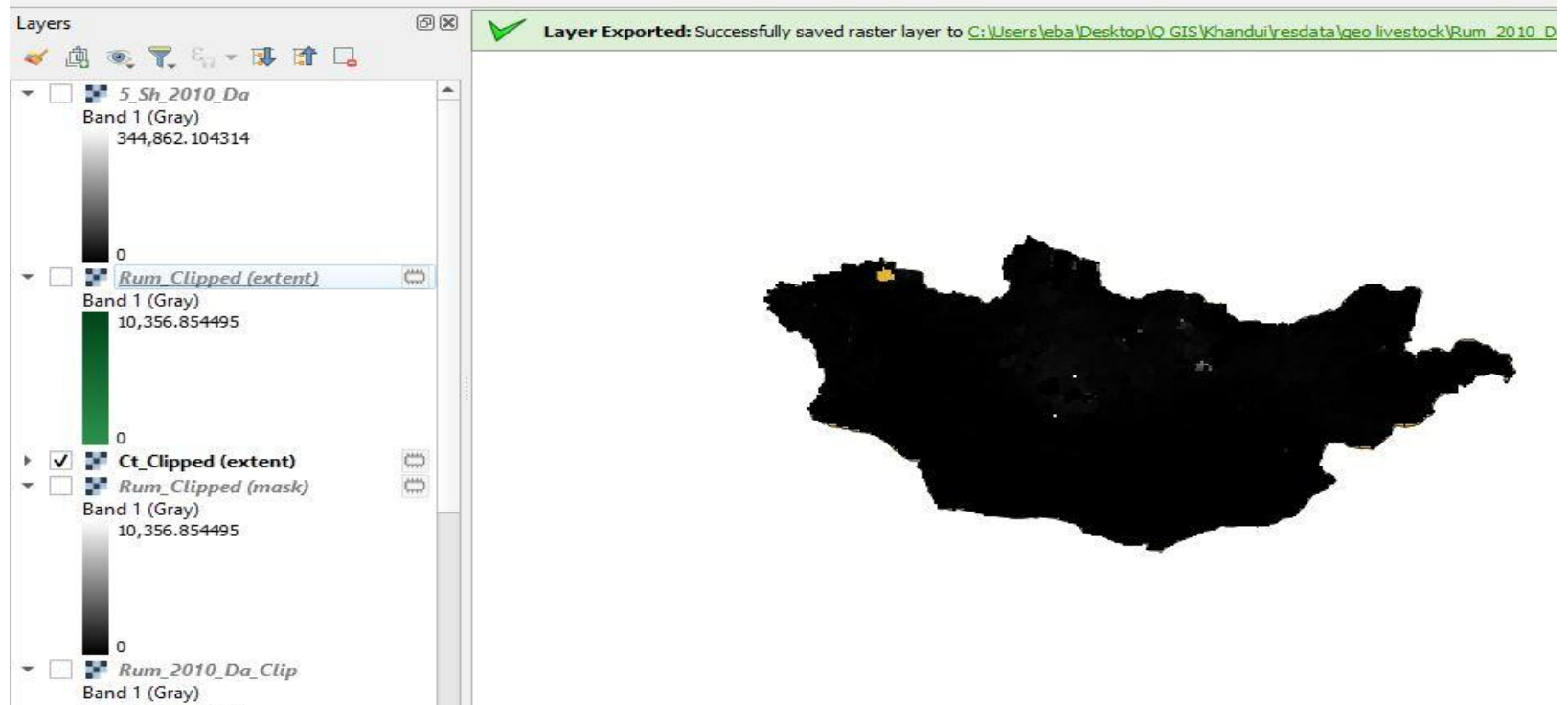
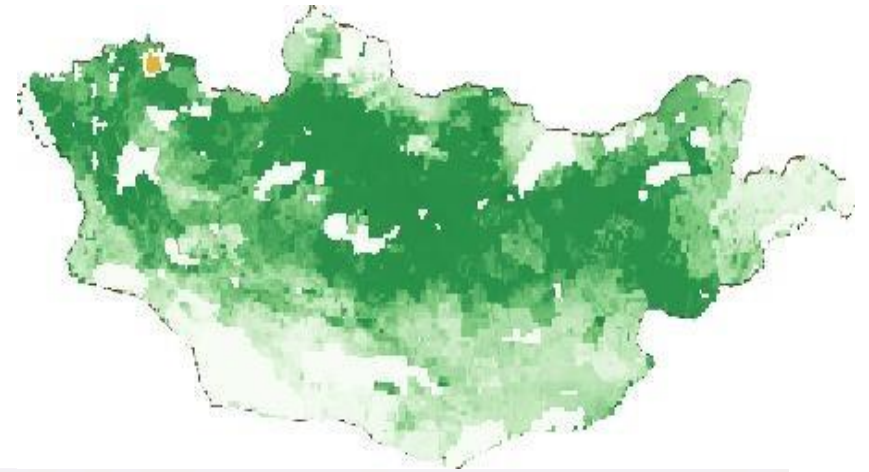
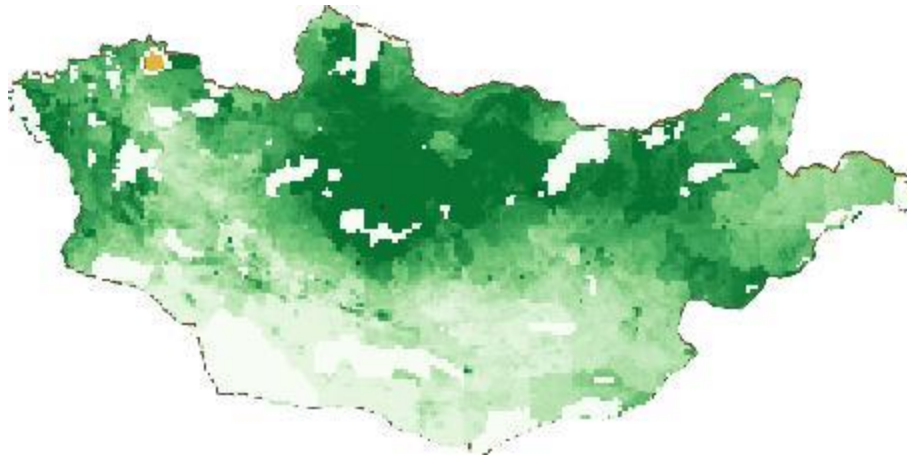


A. Primary and secondary roads



B. Primary and Secondary roads combine and raster calculation

Cattle and small ruminants population density as a raster



Combining weighted risk layers

Raster Calculator

Raster Bands

- CT_2010_Past_Prox_Norm_Inv@1
- MGL_Roads_Past_Prox_Norm_Inv@1
- MGL_Springs_Past_Prox_Norm_Inv@1
- Rumm_2010_Past_Prox_Norm_inv@1

Result Layer

Output layer: 2\ResData\Geo Final\RiskFactorsWgtd

Output format: GeoTIFF

Selected Layer Extent

X min: -761806.95970 X max: 1638962.63120

Y min: 4601779.50450 Y max: 5795645.64420

Columns: 260 Rows: 129

Output CRS: EPSG:32648 - WGS 84 / UTM zone 48N

☒ Add result to project

Operators

+	*	sqrt	cos	sin	tan	log10	(
-	/	^	acos	asin	atan	ln)
<	>	=	!=	<=	>=	AND	OR
abs	min	max					

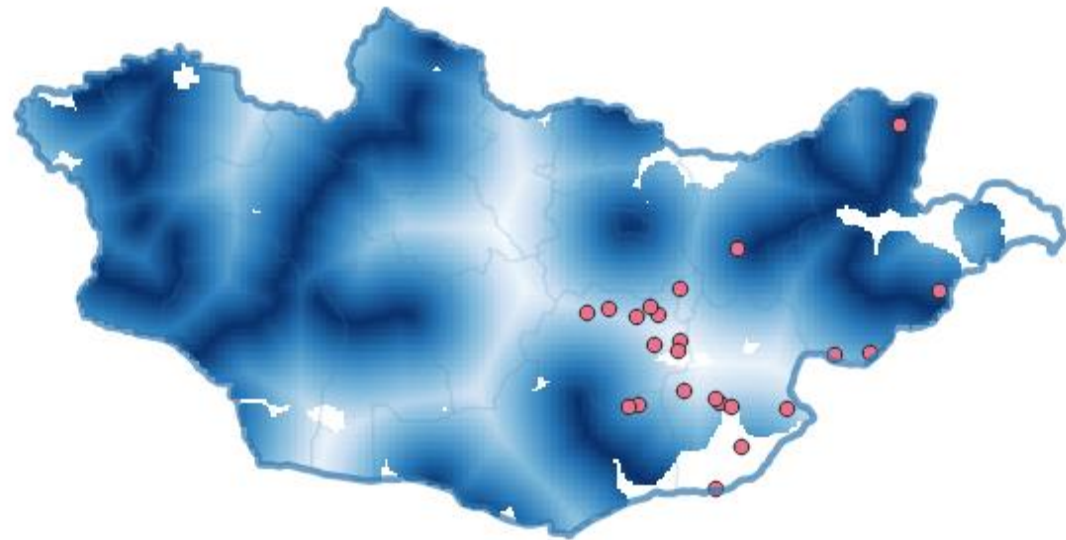
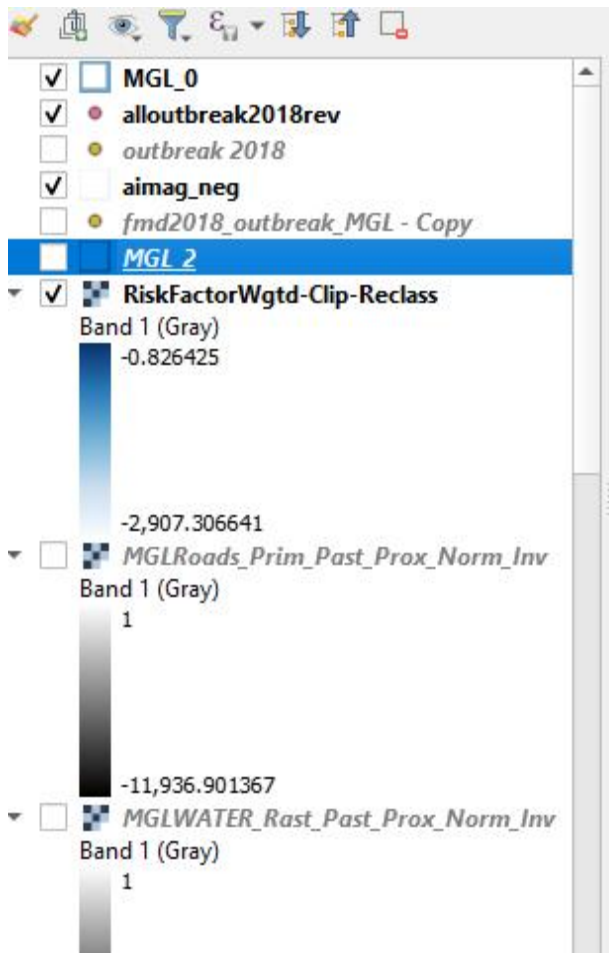
Raster Calculator Expression

```
("CT_2010_Past_Prox_Norm_Inv@1"*0.35)+("MGL_Roads_Past_Prox_Norm_Inv@1"*0.18)+  
("MGL_Springs_Past_Prox_Norm_Inv@1"*0.16)+("Rumm_2010_Past_Prox_Norm_inv@1"+0.31)
```

Expression valid

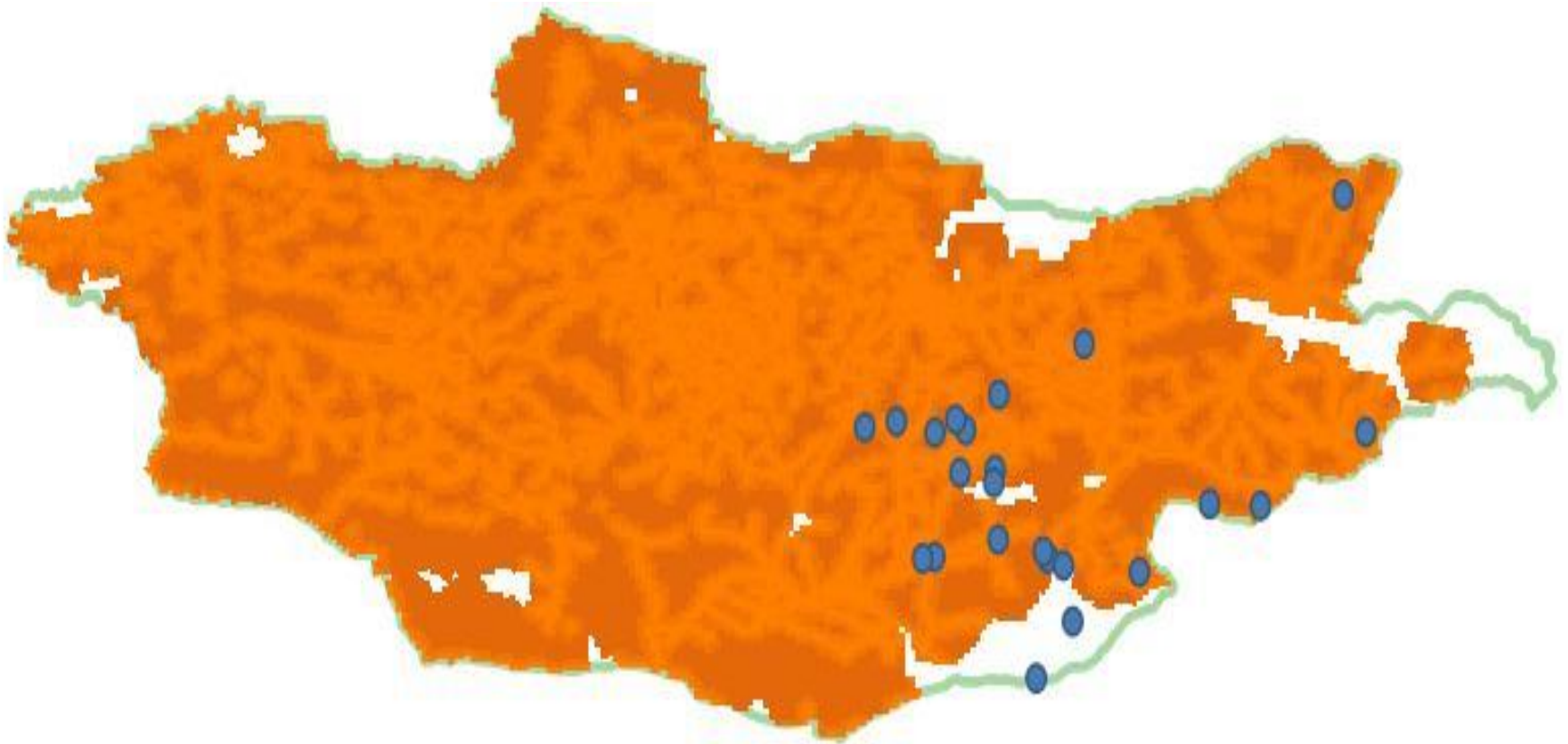
OK Cancel Help

Steps for risk combination



Discussion

- Map shown the result of the Risk combination
- Eastern part of Mongolia matched with the FMD outbreak in 2018
- Some technical errors encountered during the analysis
- Further data validation is needed and replicate the analysis.





**Thank you for your
attention**

