

Adaptation and Mitigation Initiative for Agriculture (AMIA)



Department of Agriculture
Regional Field Office XII
Koronadal City

**Climate Risk Vulnerability
Assessment (CRVA) Map for
the Province of South
Cotabato Province
*(Rice and Corn commodity)***



SENSITIVITY INDEX



HAZARD INDEX



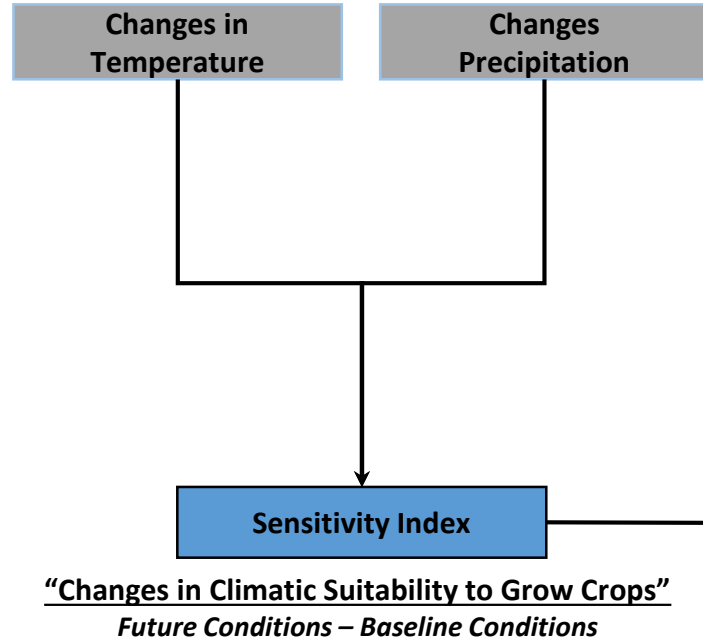
ADAPTIVE CAPACITY
INDEX



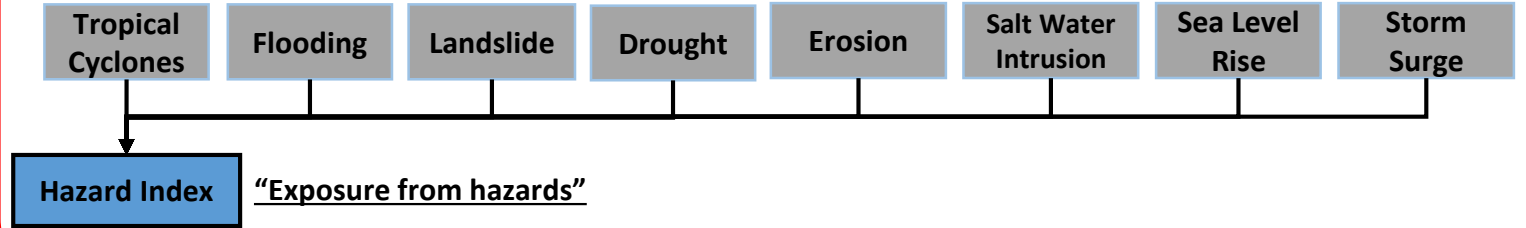
VULNERABILITY MAP

Climate-Risk Vulnerability Assessment (CRVA) Framework

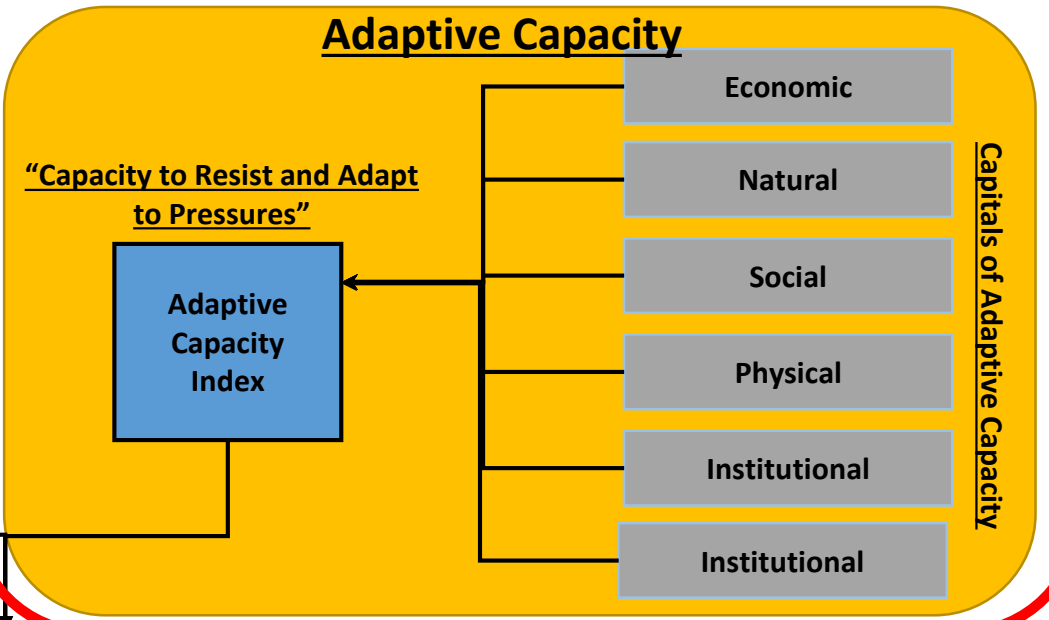
Exposure I: changes in temp. and prec.



Exposure II: Biophysical Indicators (climate-related pressures)



Adaptive Capacity



Legend:

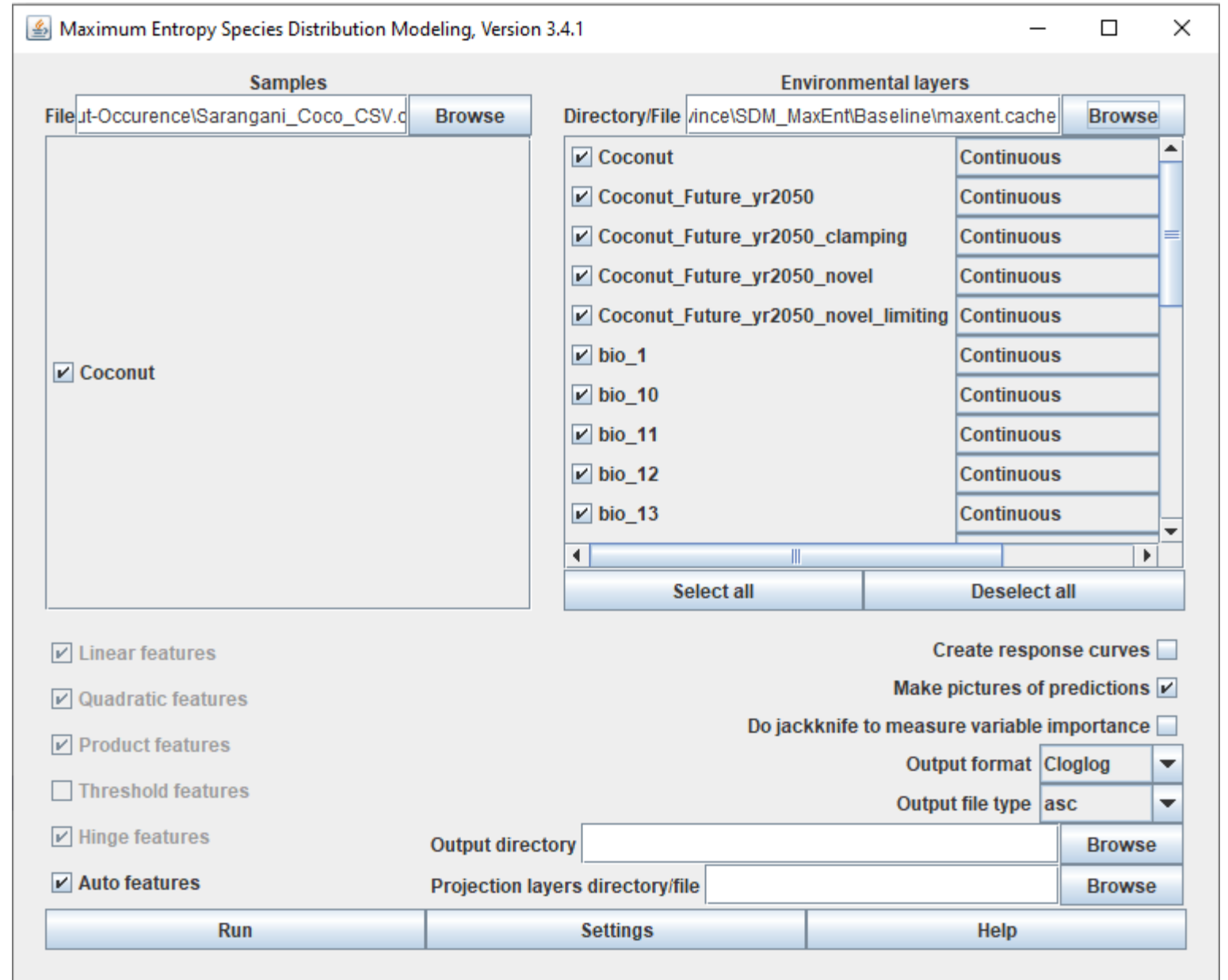




SENSITIVITY INDEX

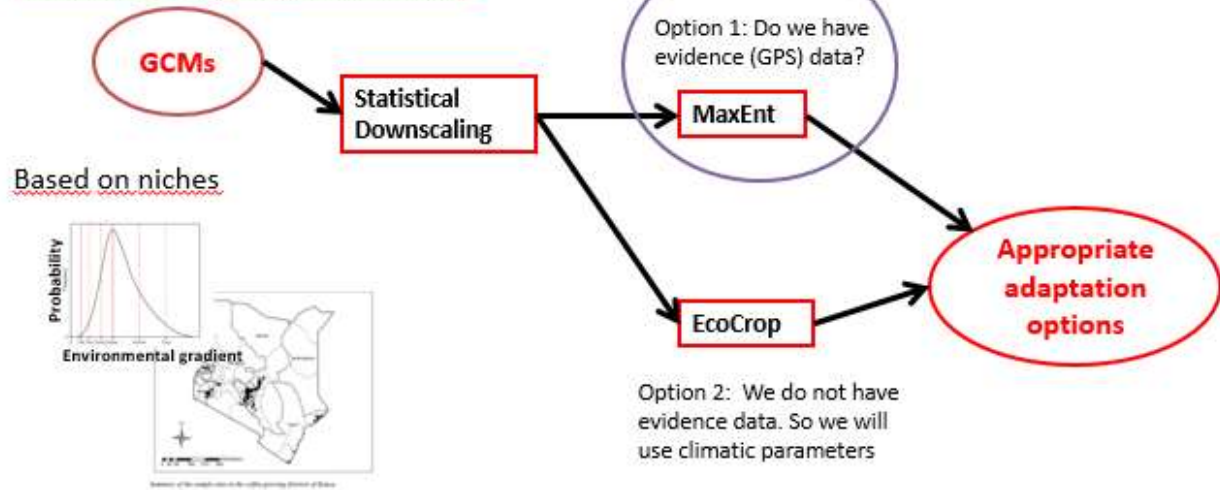


MAXENT OR MAXIMUM ENTROPY SPECIED DISTRIBUTION MODELING



How to process for Crop Distribution?

Changes in crop suitability



```

- remove these bioclim
"Bio1"
"Bio2"
"Bio3"
"Bio4"
"Bio5"
"Bio6"

"Bio8"
"Bio9"
"Bio10"

"Bio12"

"Bio14"
|
"Bio16"
"Bio17"
  
```



- Bio1 = Annual mean temperature
- Bio2 = Mean diurnal range
- Bio3 = Isothermality
- Bio4 = Temperature seasonality
- Bio5 = Maximum temperature of warmest month
- Bio6 = Minimum temperature of coldest month
- Bio7 = Temperature annual range
- Bio8 = Mean temperature of wettest quarter
- Bio9 = Mean temperature of driest quarter
- Bio10 = Mean temperature of warmest quarter
- Bio11 = Mean temperature of coldest quarter



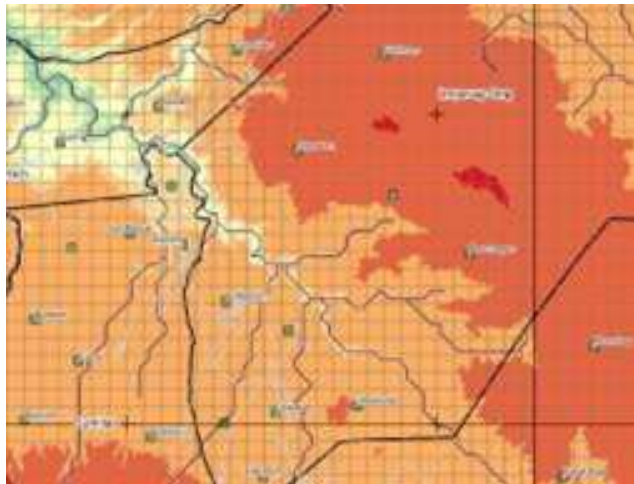
- Bio12 = Annual precipitation
- Bio13 = Precipitation of wettest month
- Bio14 = Precipitation of driest month
- Bio15 = Precipitation seasonality
- Bio16 = Precipitation of wettest quarter
- Bio17 = Precipitation of driest quarter
- Bio18 = Precipitation of warmest quarter
- Bio19 = Precipitation of coldest quarter
- Bio 20 = No. of consecutive dry days

Species Distribution Modelling (SDM)

- **SDM** evaluates the association between environmental variables and known species occurrence, and uses that information to identify space where populations could potentially occur
- SDM is also known as environment niche model, habitat model, predictive habitat distribution model, range mapping model to predict the distribution of species across geographic space and time using environmental data
- There are several implementations of SDMs: depends on the nature of your data – Presence-Absence or Presence-Only data
- Careful selection of environmental variables – Overfitting, Bias, Collinearity

Data Collection (Workshops):

 Location of crops



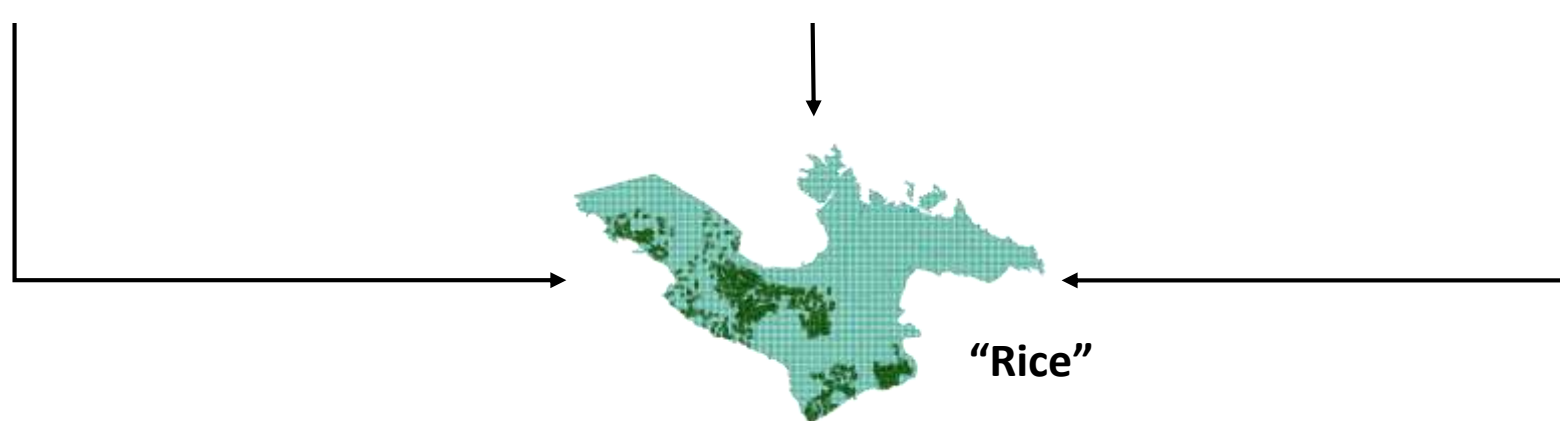
Fishnet of 1km x 1km aligned to climate grid
Other features included as reference



Staff from Local Government Units Agricultural
Department

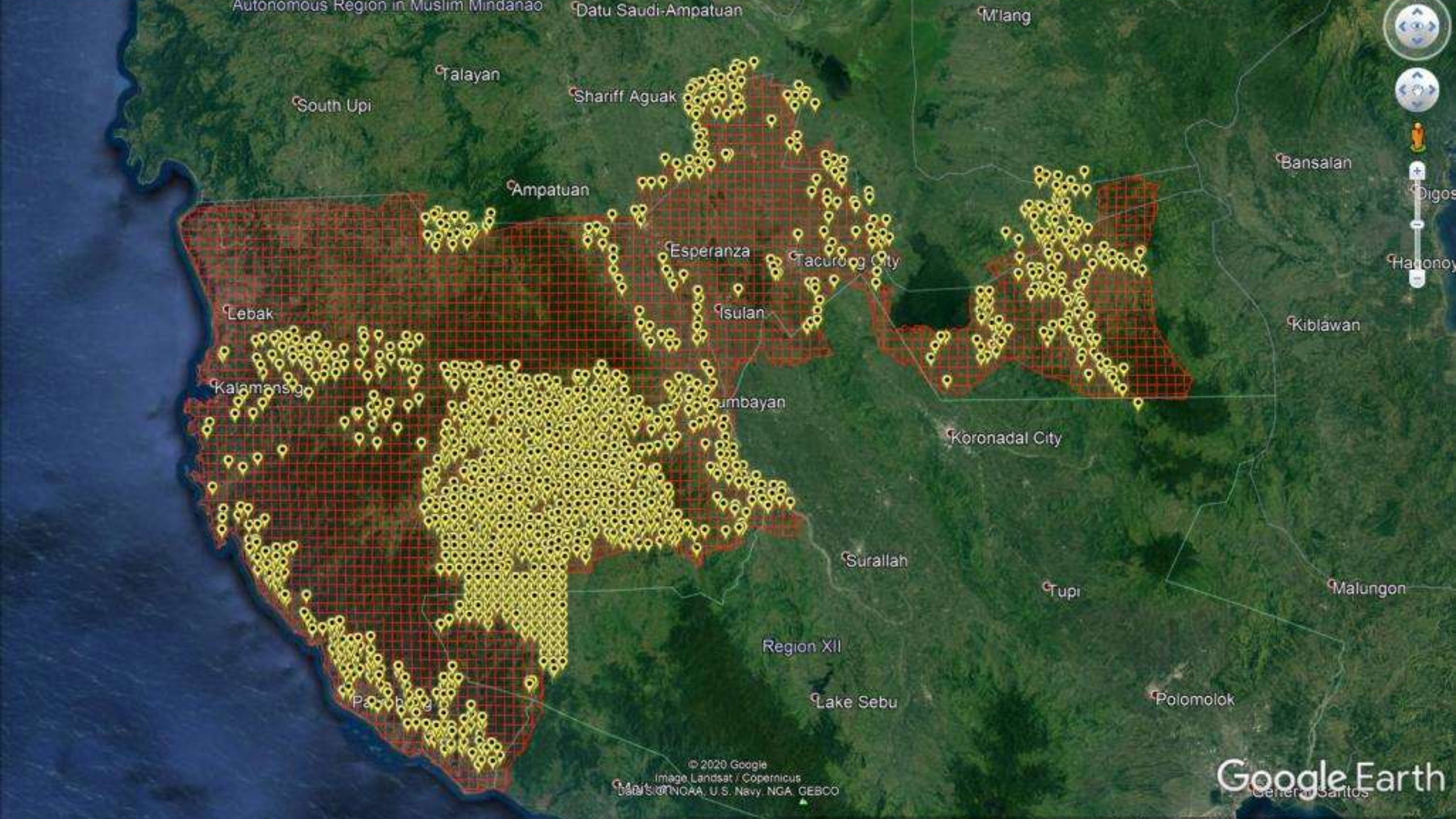


Intermediate output derived from the
workshop



DATA AND MATERIALS NEEDED TO RUN MAXENT SDM

- 1. Data on crop occurrences**
- 2. Climate data (baseline and future)**
- 3. GIS Software (QGIS preferably)**
- 4. Maxent + Java Runtime Environment**
- 5. Admin boundary – aggregate result**



Autonomous Region in Muslim Mindanao

Datu Saudi-Ampatuan

M'lang

South Upi

Talayan

Shariff Aguak

Ampatuan

Esperanza

Tacurong City

Isulan

Lebak

Kalamansig

Umbayan

Koronadal City

Bansalan

Hanonoy

Kiblawan

Surallah

Tupi

Malungon

Region XII

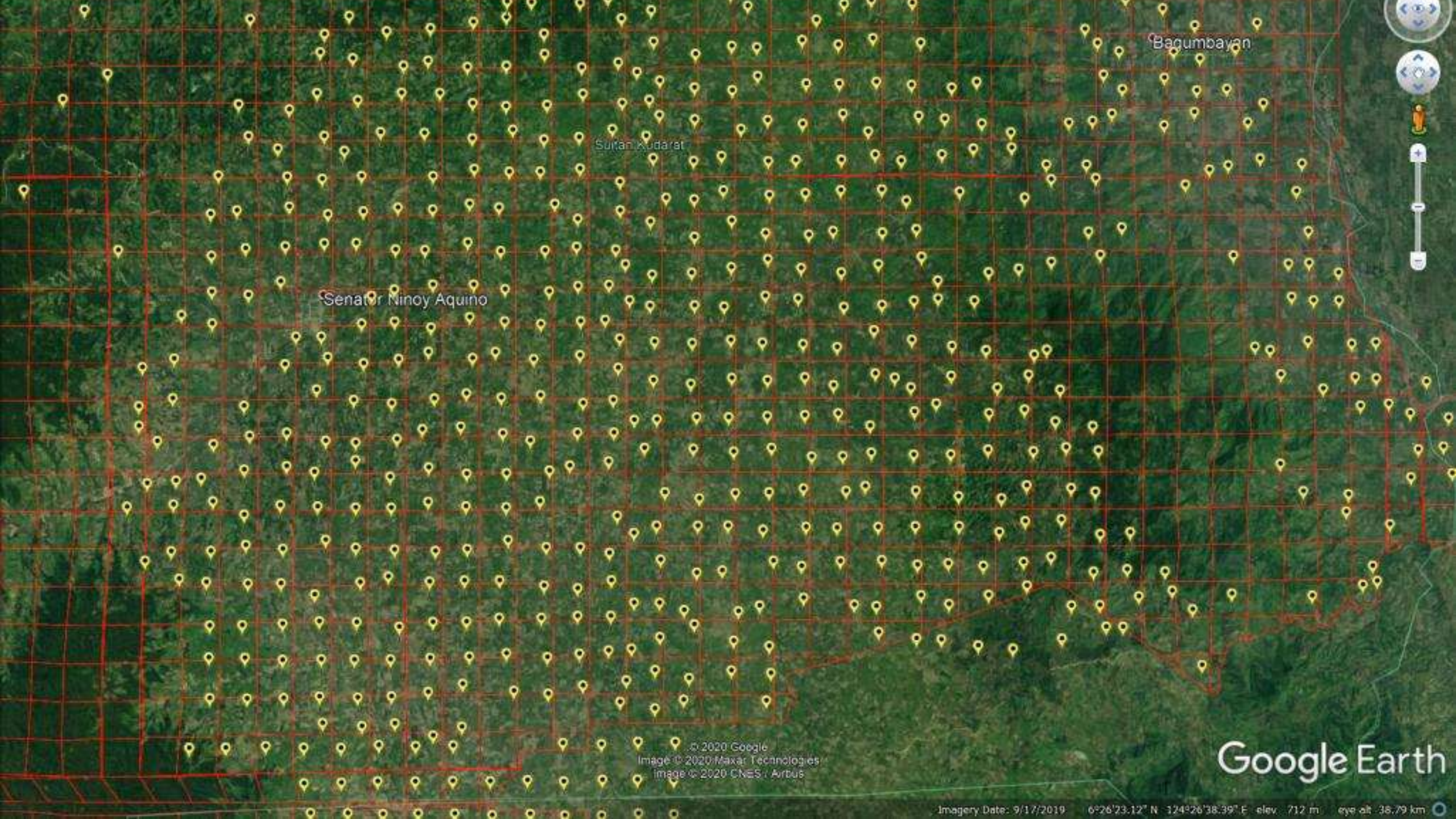
Lake Sebu

Polomolok

Pasabang

© 2020 Google
Image Landsat / Copernicus
Data SRTM30 NOAA, U.S. Navy, NGA, GEBCO

Google Earth
General Santos



Bagumbayan

Sultan Kudarat

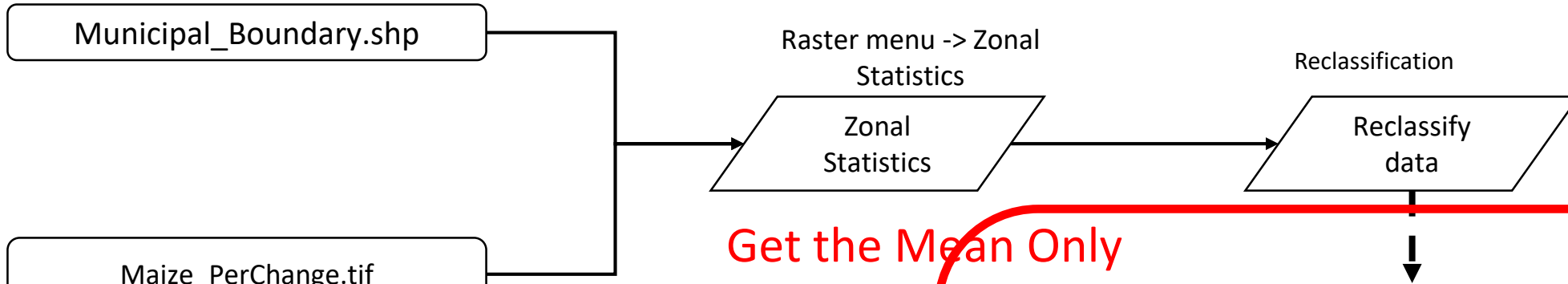
Senator Ninoy Aquino

© 2020 Google
Image © 2020 Maxar Technologies
Image © 2020 CNES / Airbus

Google Earth

Imagery Date: 9/17/2019 6°26'23.12" N 124°26'38.39" E elev. 712 m eye alt 38.79 km

Sensitivity index



Get the Mean Only

- Use query to select features
- Use field calculator to set new values for each range

$$\frac{\text{Future-Baseline}}{\text{Baseline}} \times 100$$

Description	Change (%)	Index
Negative Change	(≤ -50)	1.0
	(> -50) & (≤ -25)	0.5
	(> -25) & (≤ -5)	0.25
No Change	(> -5) & (≤ 5)	0
Positive Change	(> 5) & (≤ 25)	-0.25
	(> 25) & (≤ 50)	-0.5
	(> 50)	-1.0

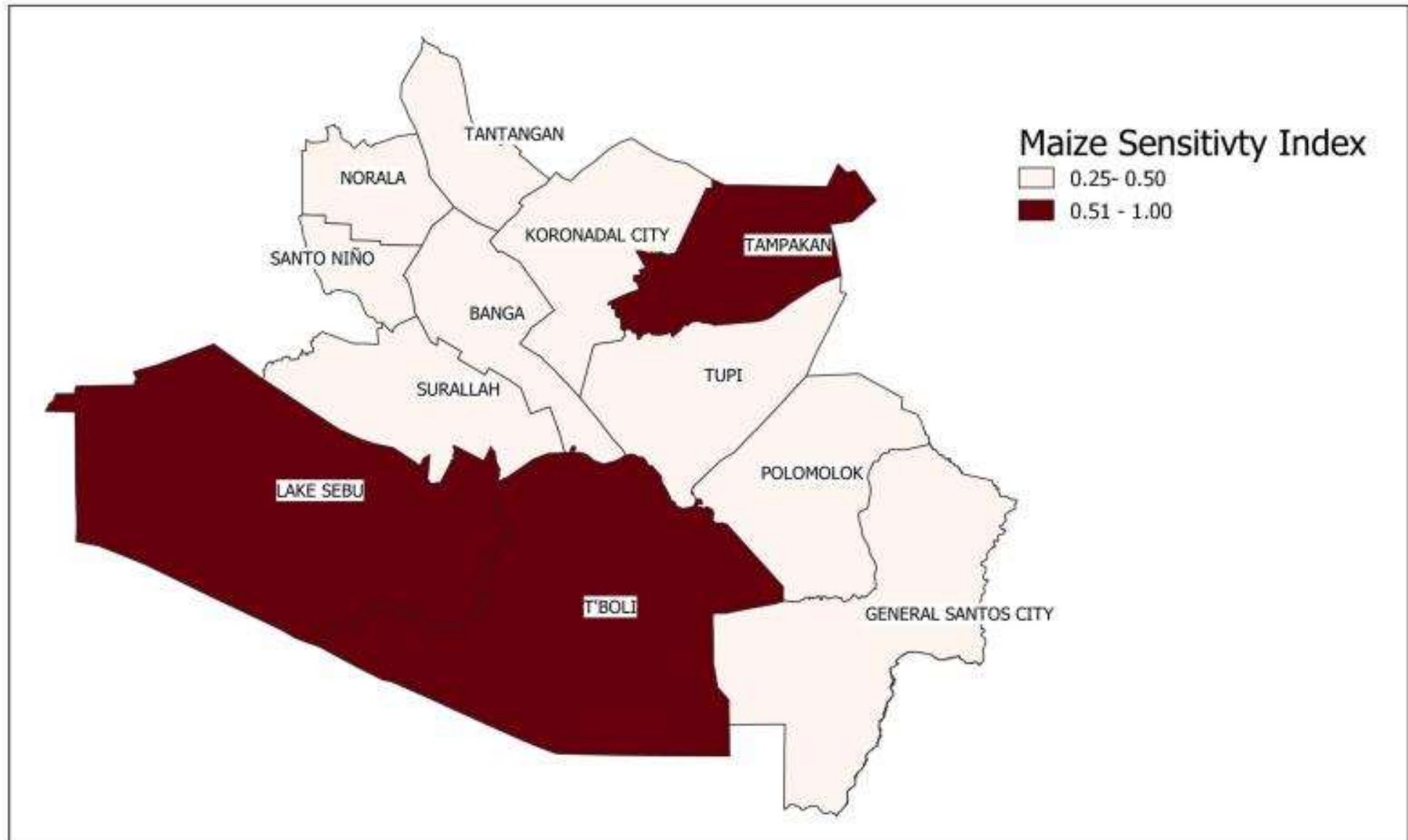
("corn_mean" > -25) AND ("corn_mean" <= -5)

Remove municipalities with low corn area

(("Corn_yr2050_avg@1" - "corn_avg@1") / "Coconut_avg@1") * 100

Municipal	Maismean	Sens_Norm
Bagumbayan	-3.249178253579880	0.00
Cumbio	24.621767871448200	-0.25
Esperanza	-6.719284586297040	0.25
Isulan	-17.340265623720200	0.25
Kalamansig	-37.732436249879200	0.50
Lambayong	-24.326800685233700	0.25
Lebak	-1.287907914225780	0.00
Lutayan	-16.622485139966000	0.25
Palimbang	-4.874474546317830	0.00
Pres. E. Quirino	-25.521273173936900	0.50
Sen. Ninoy Aquino	-22.469199350322300	0.25
Tacurong City	-13.423943605596900	0.25

PROVINCE OF SOUTH COTABATO (SENSITIVITY MAP)



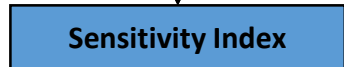
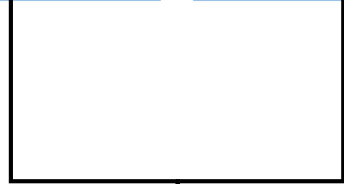


HAZARD INDEX



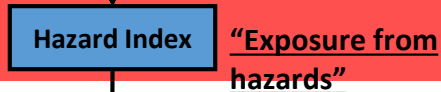
Climate-Risk Vulnerability Assessment (CRVA) Framework

Exposure I: changes in temp. and prec.



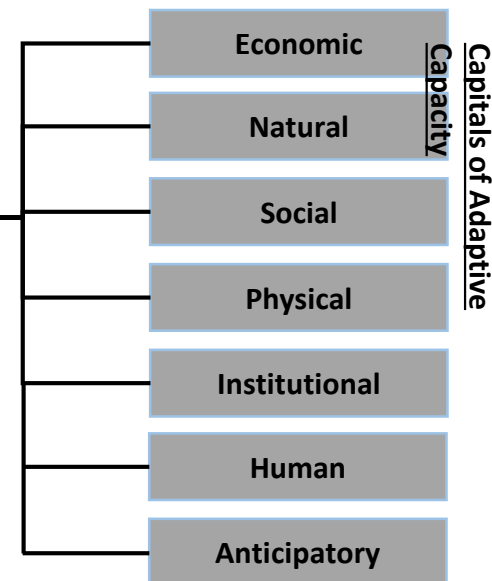
“Changes in Climatic Suitability to Grow Crops”
Future Conditions – Baseline Conditions

Exposure II: Biophysical Indicators (climate-related pressures)



Adaptive Capacity

“Capacity to Resist and Adapt”



“Climate-Risk Vulnerability”

Legen



Generating Hazard Index

|-----Hazards (Folder)

|-----CB_Cyclone_norm.tif

|-----CB_Drought_norm.tif

|-----CB_Flood_norm.tif

|-----CB_Landslide_norm.tif

|-----CB_SaltWaterIntrusion_norm.tif

|-----CB_SeaLevelRise_norm.tif

|-----CB_SoilErosion.tif

|-----CB_StormSurge.tif

Exposure II: Biophysical Data on Natural Hazards

Exposure II: Biophysical Indicators (climate-related pressures)



- Exposure II** also known as **Exposure from Hazards**, is one of the components of the CRVA Framework.
- It comprises the **Biophysical Indicators** (climate-related pressure) such as tropical cyclones, flooding, landslide, drought, erosion, salt water intrusion, sea level rise and storm surge.
- By assigning different weights for each hazard with respect to the three island groups in the Philippines, the Hazard Index will be generated.

Exposure II: Assign hazard weights – done with experts

Weights (%) →								
Criteria	Typhoon	Flooding	Drought	Erosion	Landslide	Storm Surge	Sea Level Rise	Salt Water Intrusion
Probability of Occurrence								
Impact to Nat'l Economy								
Impact to Food Security of the Country								
Impact to Local Household Income								
Impact to Key Natural Resources to Sustain Productivity (i.e., water quality & quantity, biodiversity, soil fertility)								

Weighting the natural hazards into a climate risk exposure

Probability of occurrence: { 5 = once in every year,
3 = once in every 5 years,
1 = once every 10 years or less }

Impact: { 5 = Disastrous,
4 = Significant,
3 = Moderate
2 = Minor
1 = Insignificant }

Exposure II: Assign hazard weights – done with experts

	Typhoon					Drought					Erosion				
Criteria	Expert 1	Expert 2	Expert 3	Expert 4	Ave .	Expert 1	Expert 2	Expert 3	Expert 4	Ave .	Expert 1	Expert 2	Expert 3	Expert 4	Ave .
Probability of Occurrence	5	5	5	5	5	3	3	3	3	3	3	5	3	3	3.50
Impact to National Economy	3	4	5	4	4	3	4	2	1	2.50	3	3	3	2	2.75
Impact To Food Security of the Country	3	5	4	4	4	3	4	2	1	2.50	3	3	2	1	2.25
Impact to Local Household Income	5	4	4	5	4.50	5	4	2	3	3.50	2	3	3	4	3
Impact to Key Natural Resources to Sustain Productivity (i.e., water quality & quantity)	4	4	5	4	4.25	4	3	2	3	3	2	3	3	4	3
Criteria	Typhoon		Drought	Erosion	Landslide	Storm Surge	Sea Level Rise	Saltwater Int.							
Probability of Occurrence	5.00		3.00	3.50	3.50	1.00	1.00	1.00							
Impact to National Economy	4.00		2.50	2.75	3.00	1.00	1.00	1.00							
Impact To Food Security of the Country	4.00		2.50	2.25	2.25	1.00	1.00	1.00							
Impact to Local Household Income	4.50		3.50	3.00	3.00	1.00	1.00	1.00							
Impact to Key Natural Resources to Sustain Productivity (i.e., water quality & quantity, biodiversity, soil fertility)	4.25		3.00	3.00	3.25	1.00	1.00	1.00							
Total	21.75		14.50	14.50	15.00	5.00	5.00	5.00	80.75						
Hazard Weights	26.93		17.96	17.96	18.58	6.19	6.19	6.19	100.00						

Exposure II: Hazards Weights by Island Group

HAZARDS

- Different degree
- Intensity and frequency
- Potential damage

ISLAND GROUPS

- Unique in terms of exposure to hazards
- Rainfall pattern
- Land form
- Crop distribution

Hazards	Island Group		
	Luzon	Visayas	Mindanao
Tropical Cyclones	20.00	18.21	16.95
Flood	19.05	16.40	15.25
Landslide	8.57	10.72	14.41
Erosion	11.43	12.57	12.71
Drought	14.25	16.17	16.95
Saltwater Intrusion	11.43	7.21	10.17
Sea Level Rise	5.71	8.33	5.08
Storm Surge	9.52	10.39	8.48

Exposure II: Biophysical Data on Natural Hazards

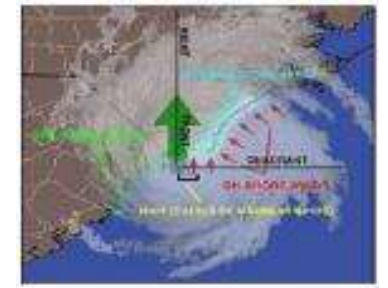


Tropical Cyclones x 16.95

Flood x 15.25

Landslide x 14.41

Drought x 12.71

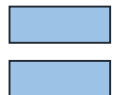


Erosion x 16.95

Salt Water
Intrusion x 10.17

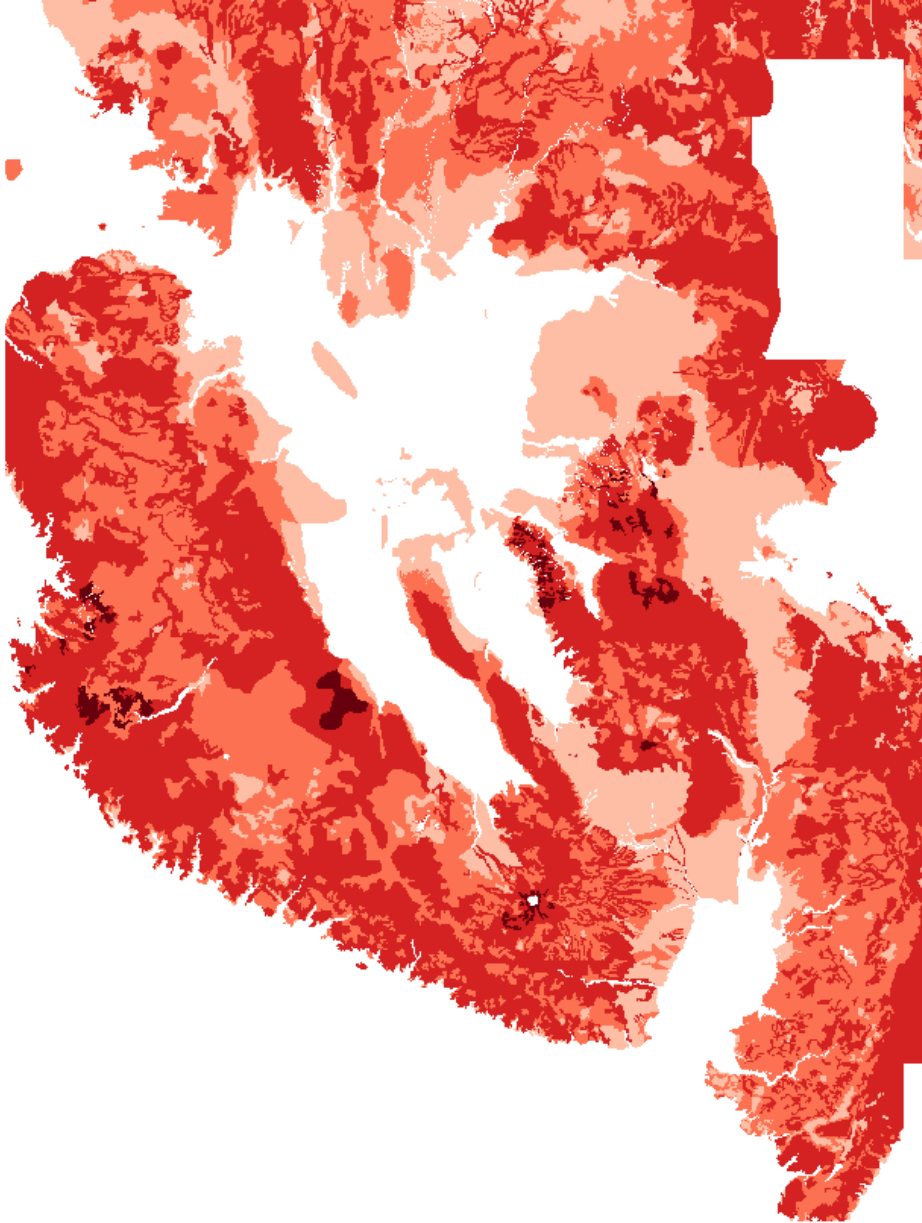
Sea Level Rise x 5.08

Storm Surge
x 8.48



Hazard Index
“Exposure from hazards”

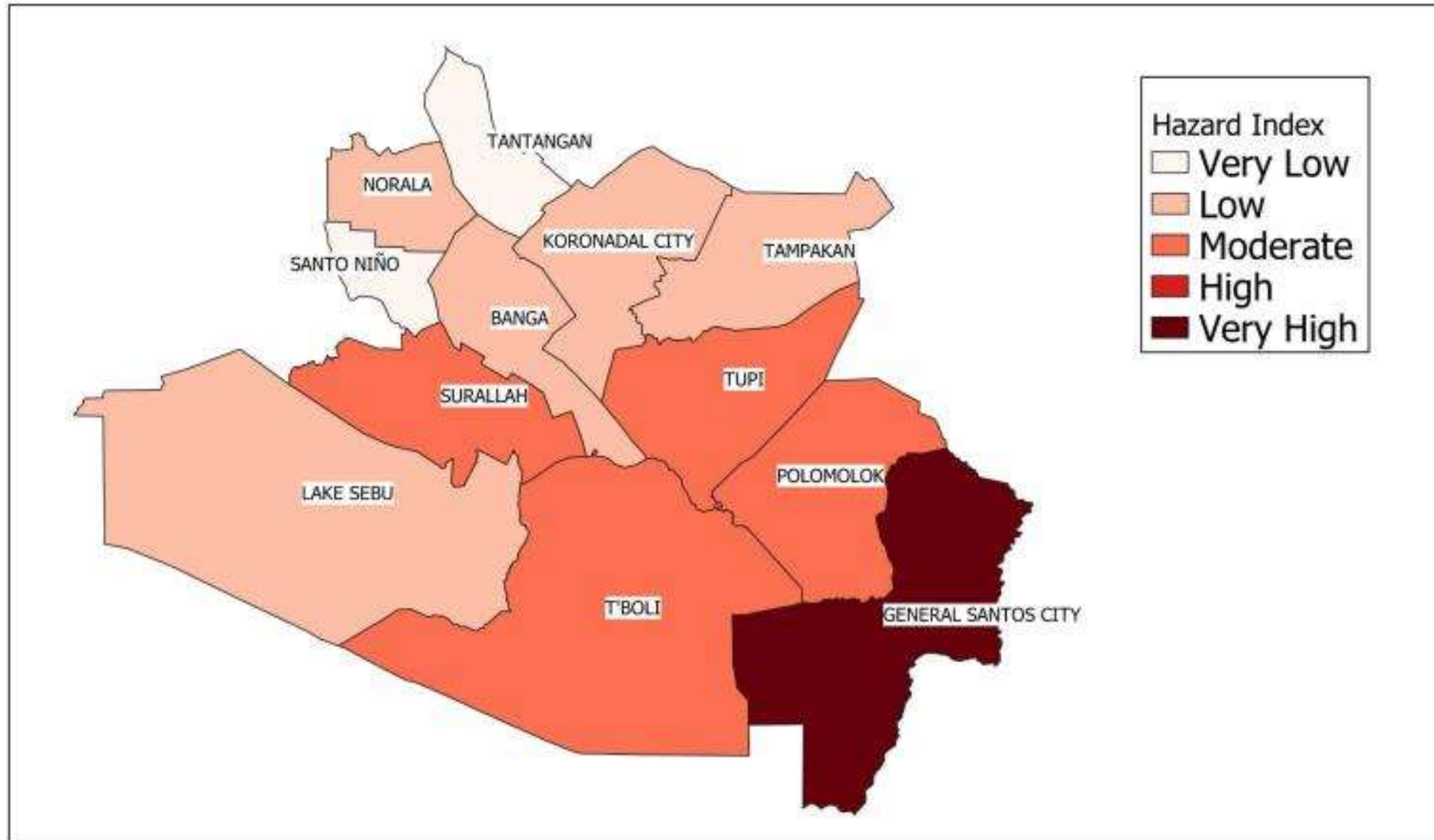
LANDSLIDE



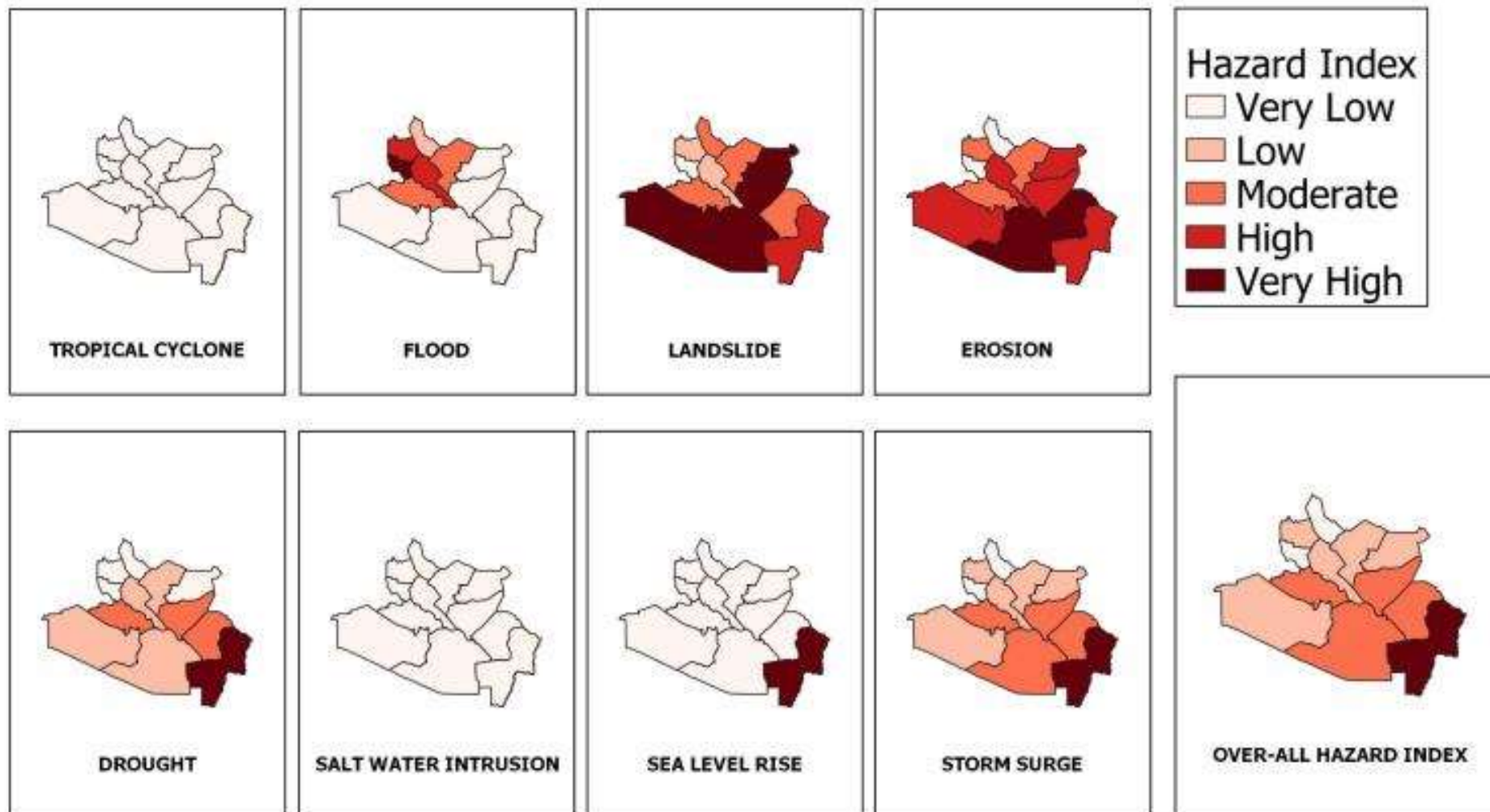
TROPICAL CYCLONE



PROVINCE OF SOUTH COTABATO (HAZARD MAP)



PROVINCE OF SOUTH COTABATO (HAZARD MAP)

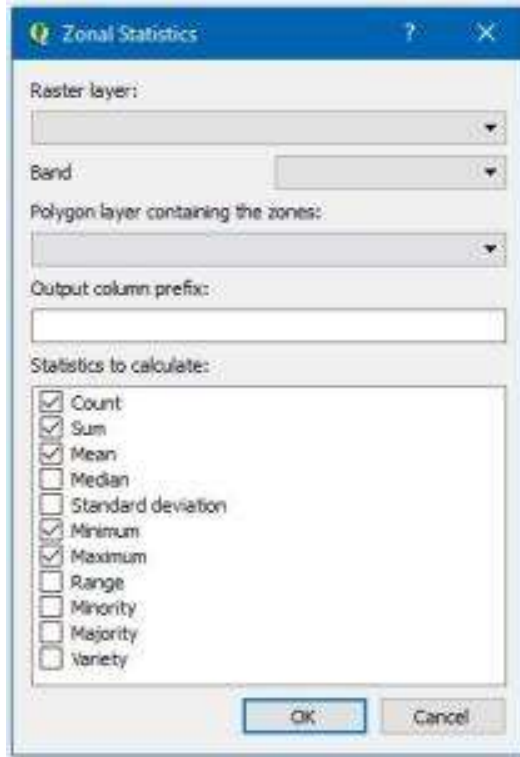




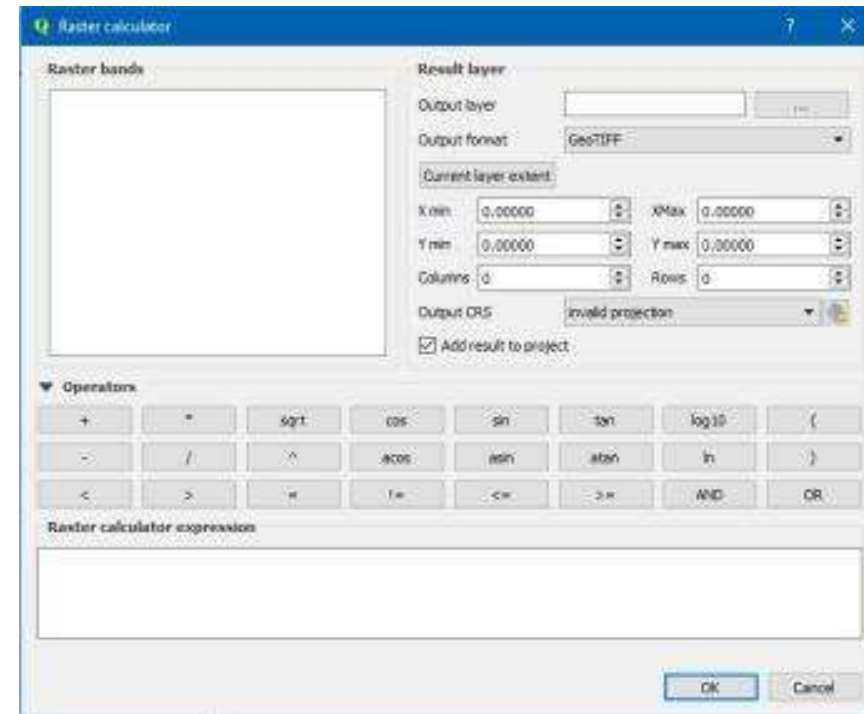
ADAPTIVE CAPACITY INDEX

Step by Step: Generating Hazard Index

Step 1: Zonal Statistics



Step 3: Apply Hazard Weights and Generate Hazard Index



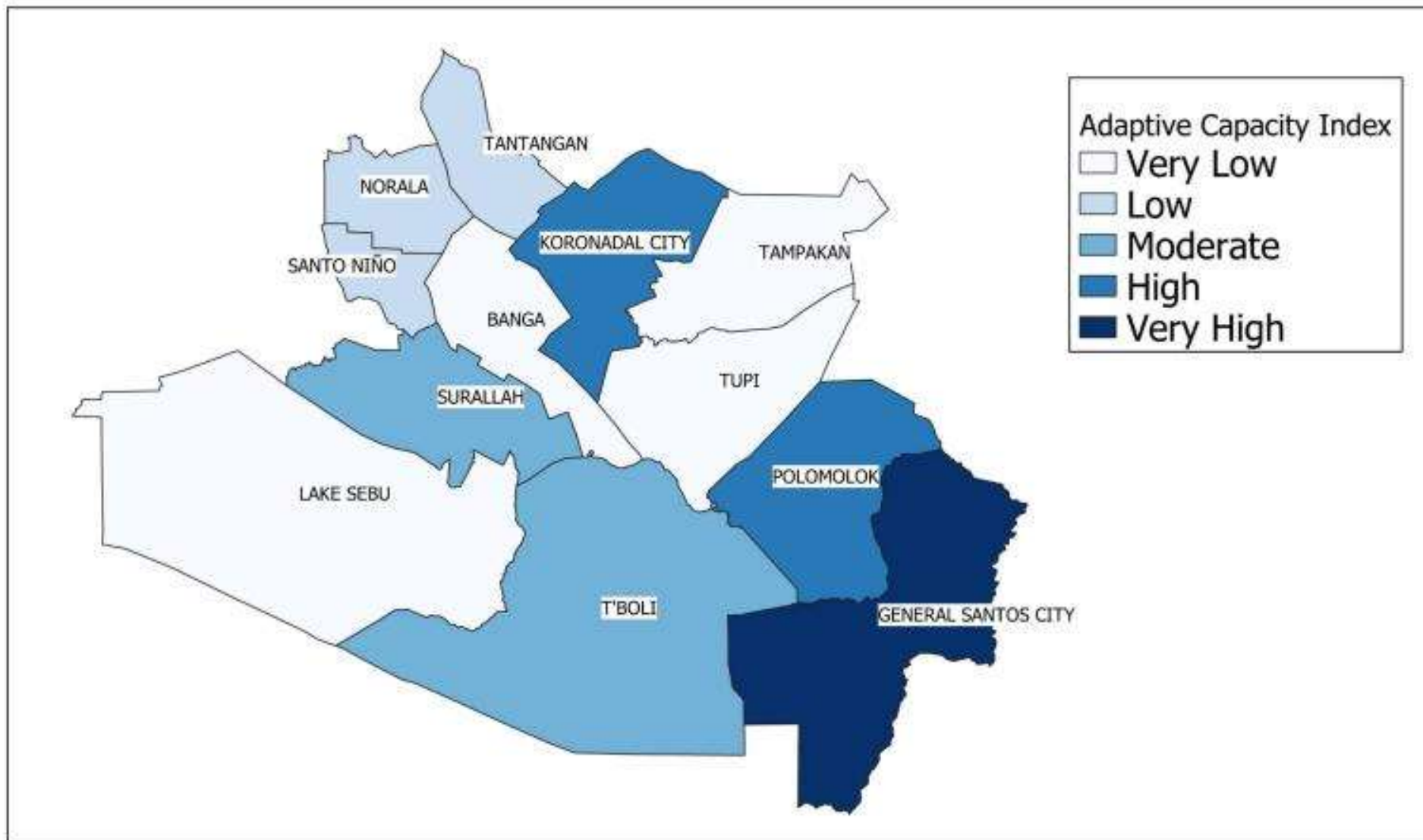
Step 2: Normalize Hazard values

$$X_n = \frac{(X - X_{min})}{(X_{max} - X_{min})}$$

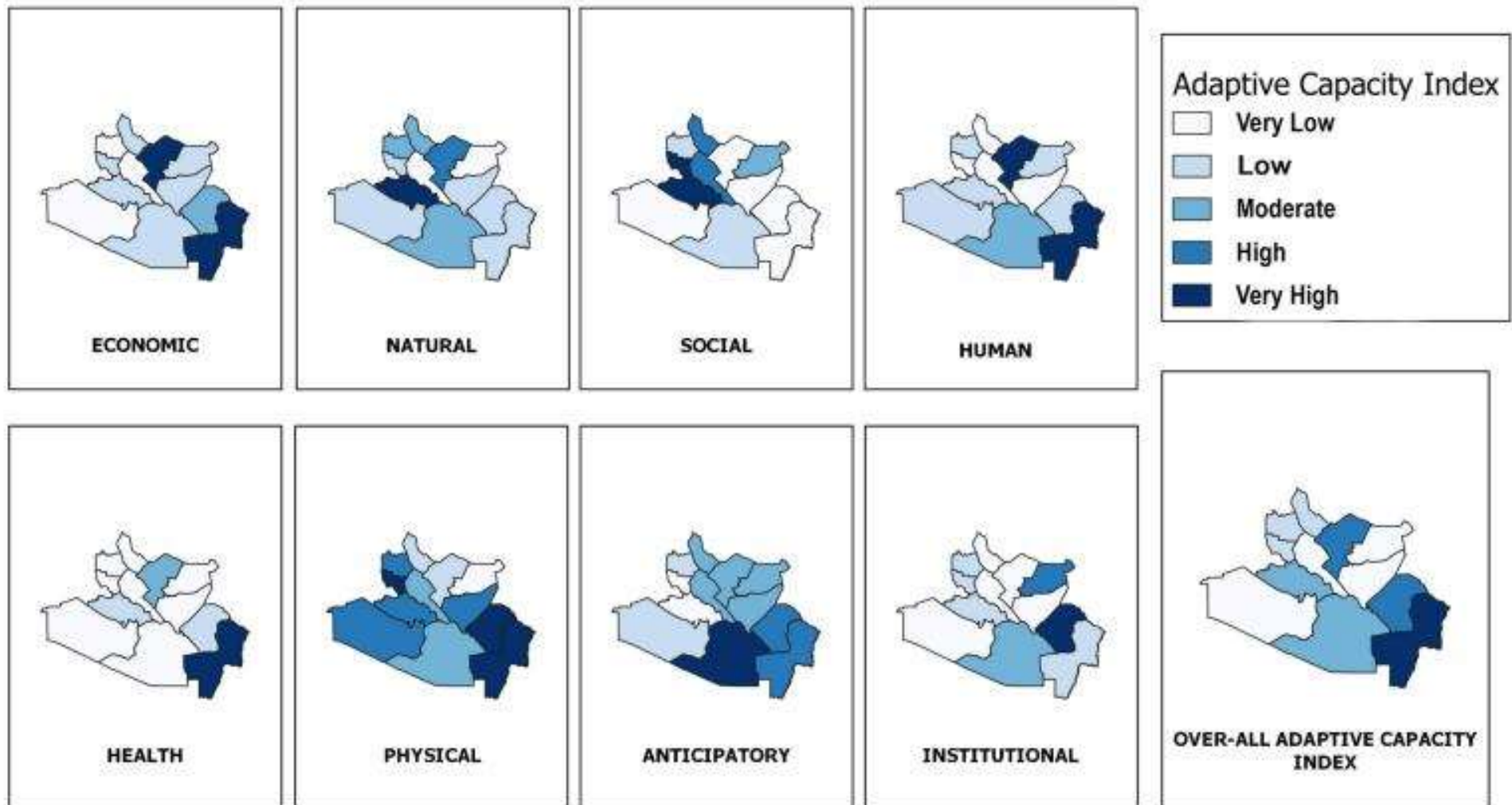
Step 4: Normalize Hazard Index

$$X_n = \frac{(X - X_{min})}{(X_{max} - X_{min})}$$

PROVINCE OF SOUTH COTABATO (ADAPTIVE CAPACITY)

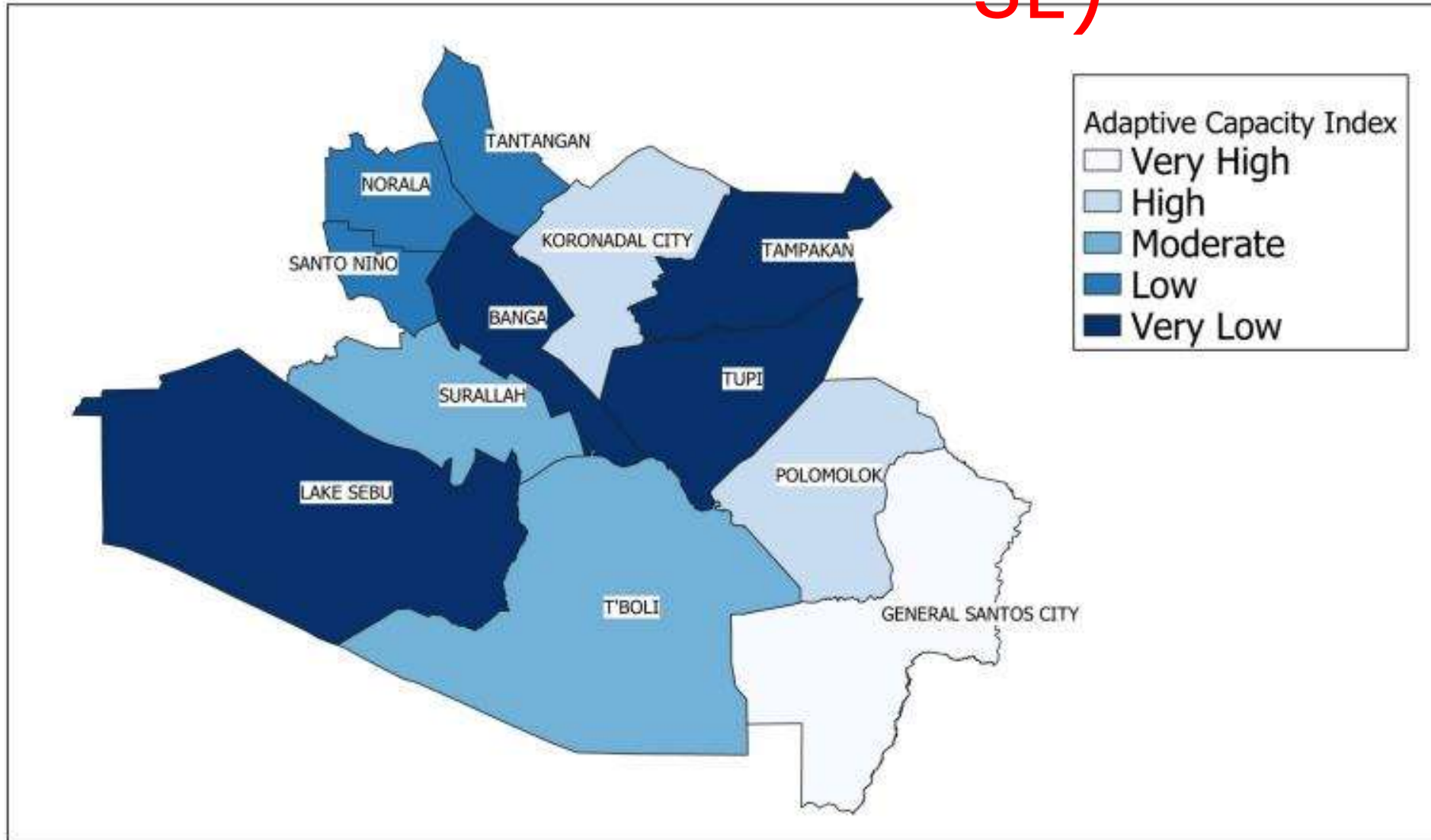


PROVINCE OF SOUTH COTABATO (ADAPTIVE CAPACITY)



PROVINCE OF SOUTH COTABATO (ADAPTIVE CAPACITY)

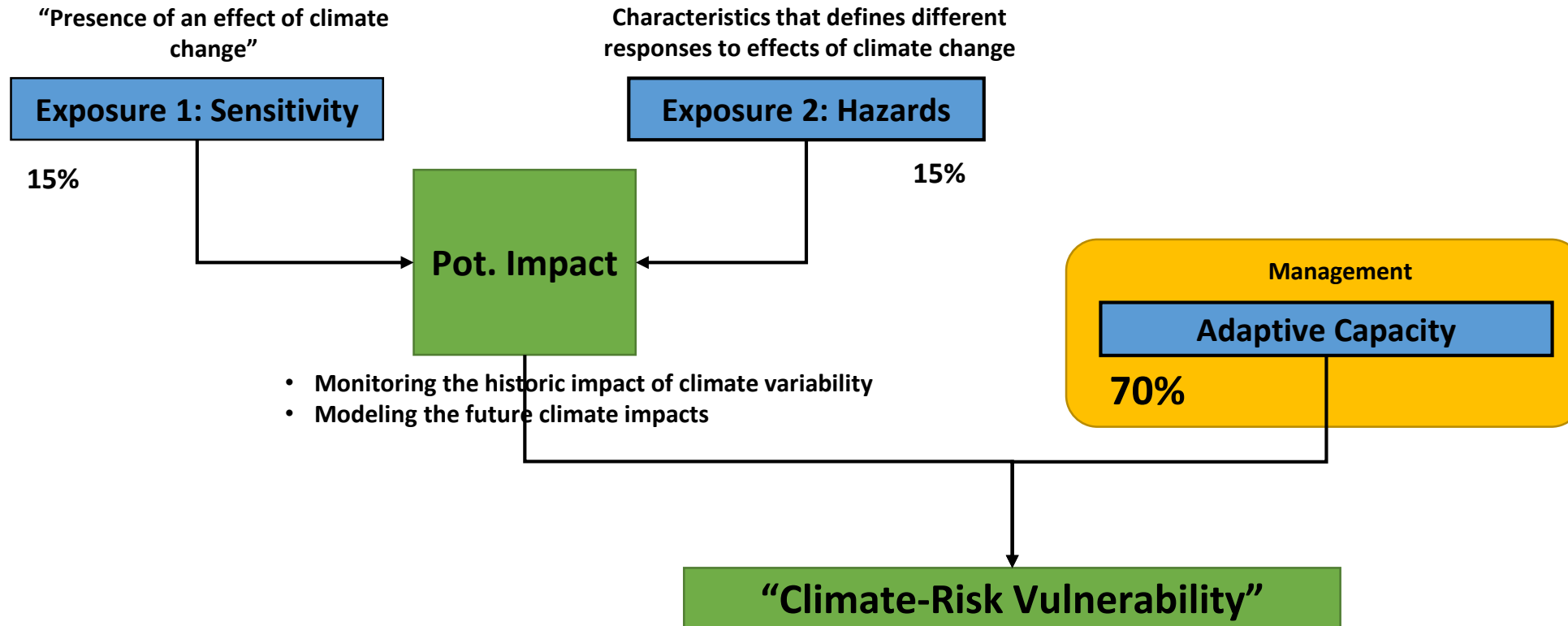
(REVERSE)





VULNERABILITY MAP

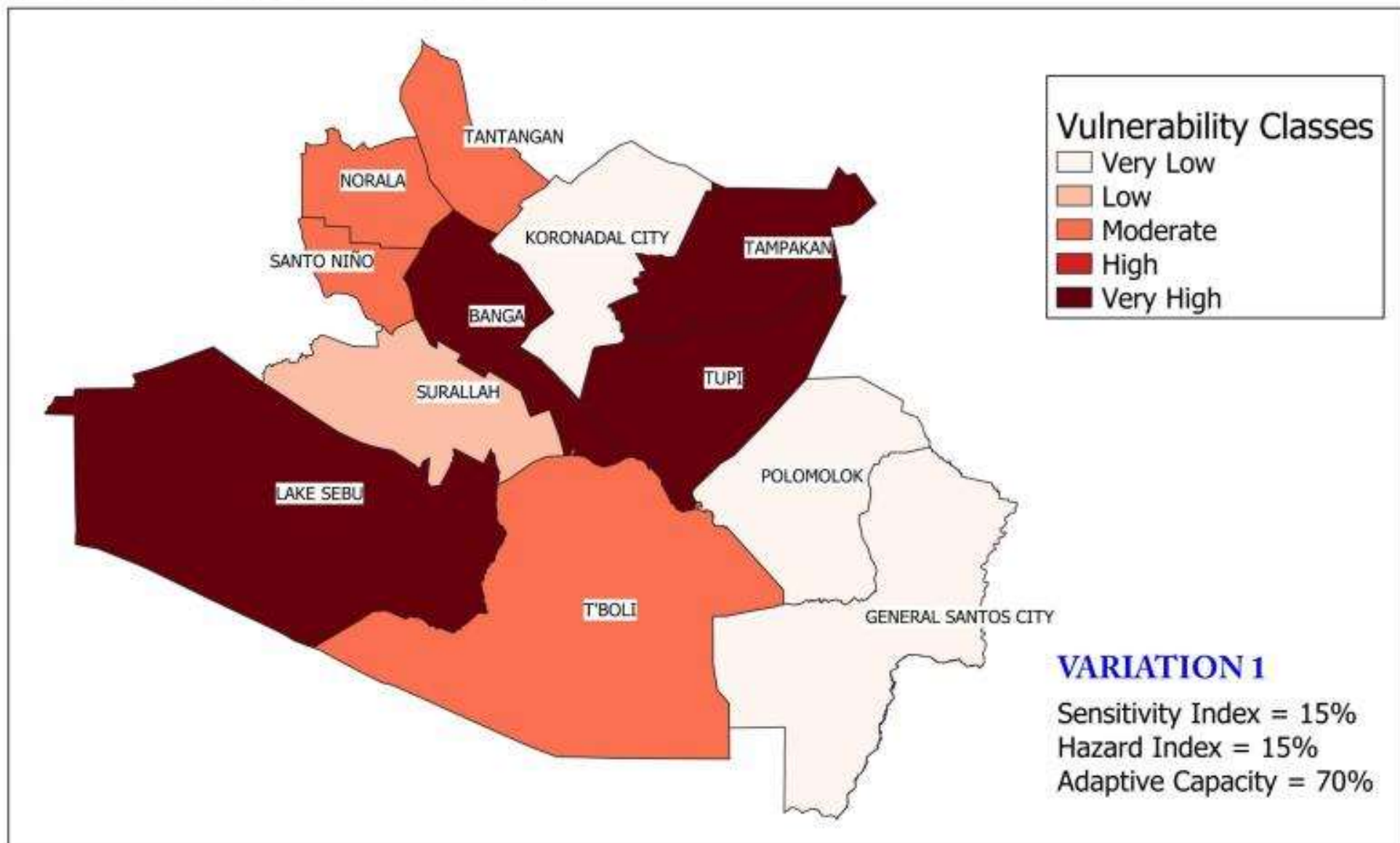
Climate-Risk Vulnerability Assessment (CRVA) Framework



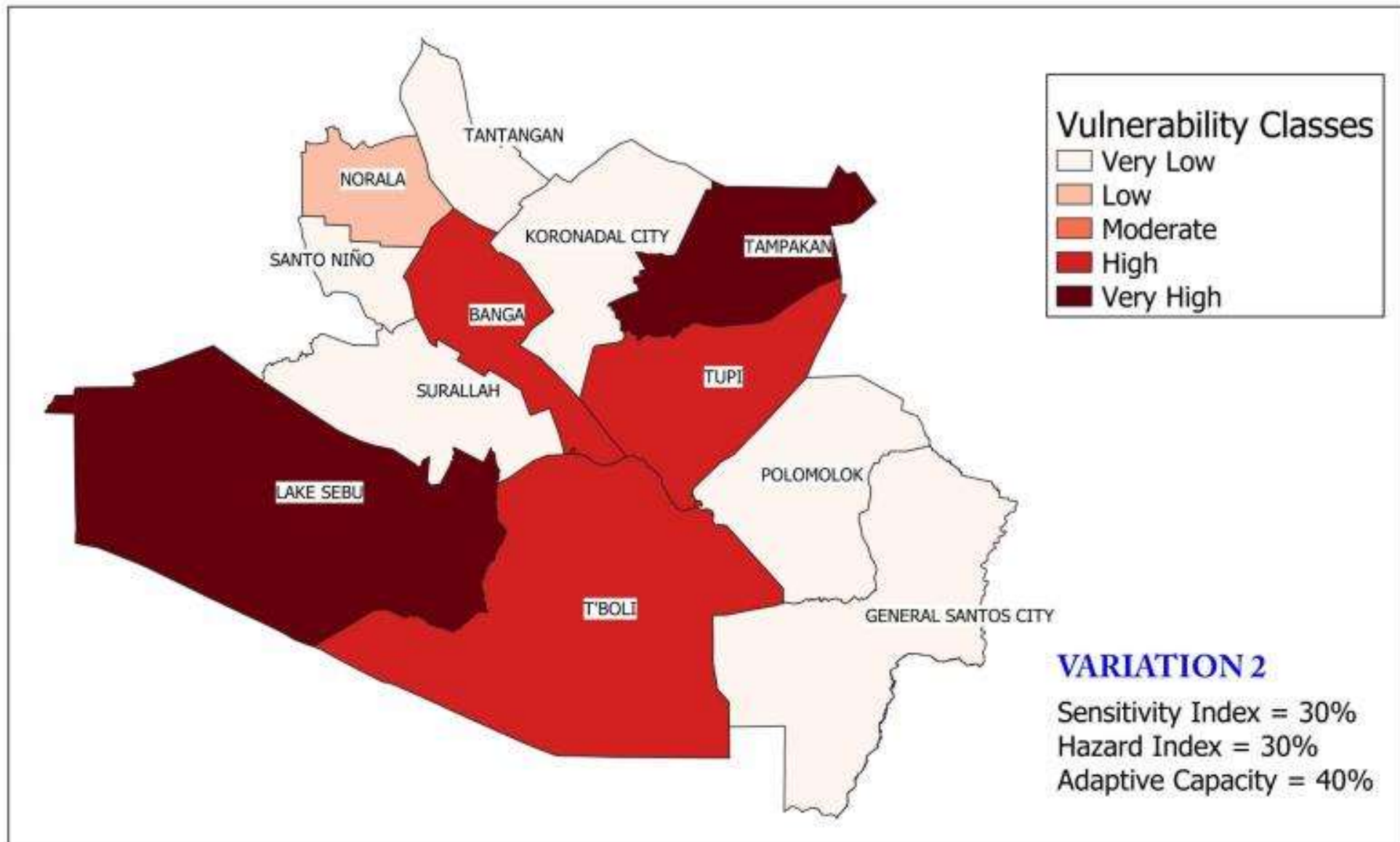
CORN COMMODI TY

Mun_Name	Corn_V1_ Norm	Corn_V2_ Norm	Corn_V3_ Norm
BANGA	0.85	0.64	0.59
GENERAL SANTOS CITY	0.00	0.20	0.34
KORONADAL CITY	0.15	0.00	0.00
NORALA	0.60	0.36	0.32
POLOMOLOK	0.19	0.09	0.12
SURALLAH	0.31	0.20	0.22
TAMPAKAN	0.84	0.86	0.88
TANTANGAN	0.56	0.20	0.12
T'BOLI	0.57	0.73	0.80
TUPI	0.85	0.66	0.61
SANTO NIÑO	0.46	0.14	0.10
LAKE SEBU	1.00	1.00	1.00
1st			
2nd			
3rd			

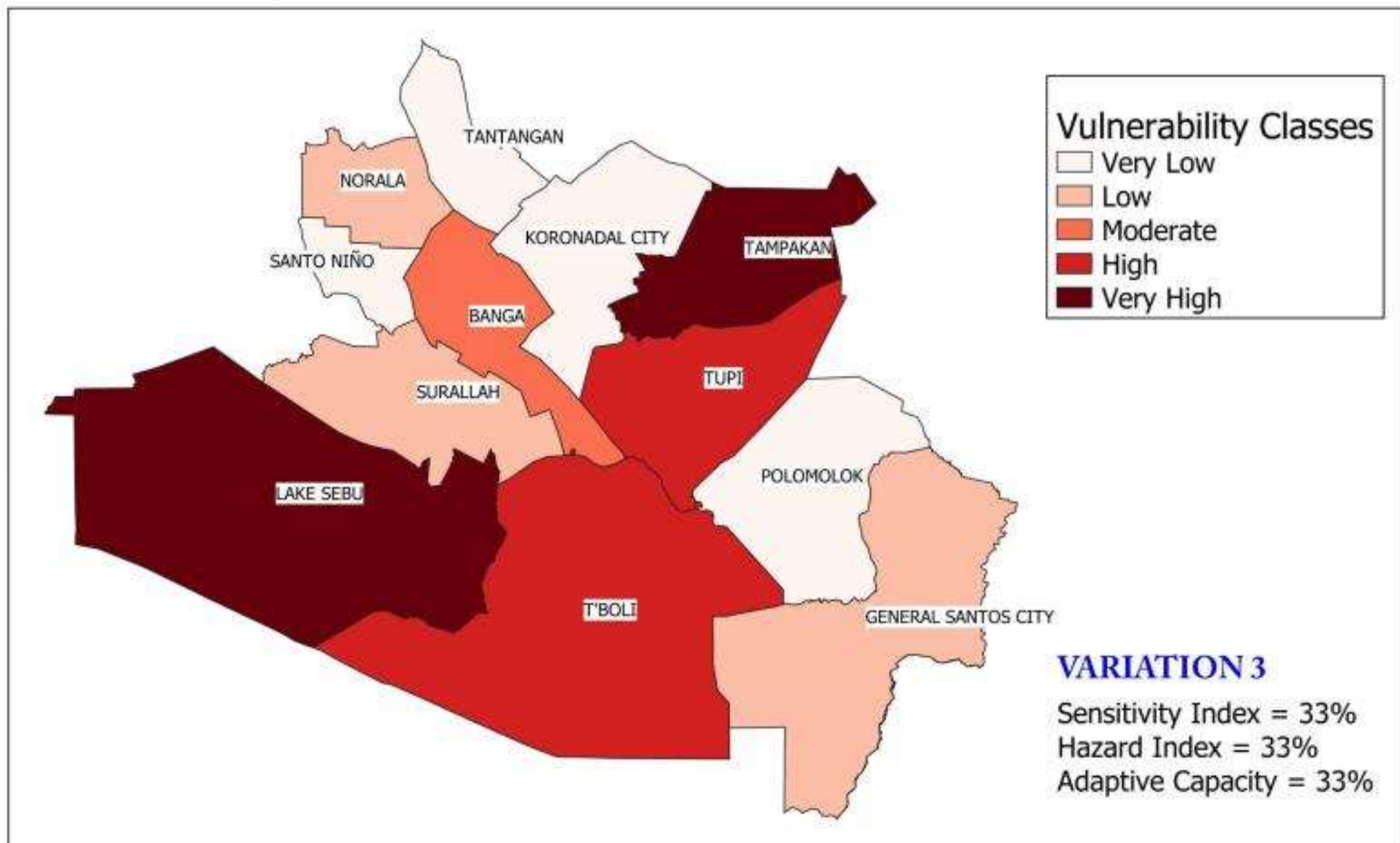
PROVINCE OF SOUTH COTABATO (VULNERABILITY MAP)



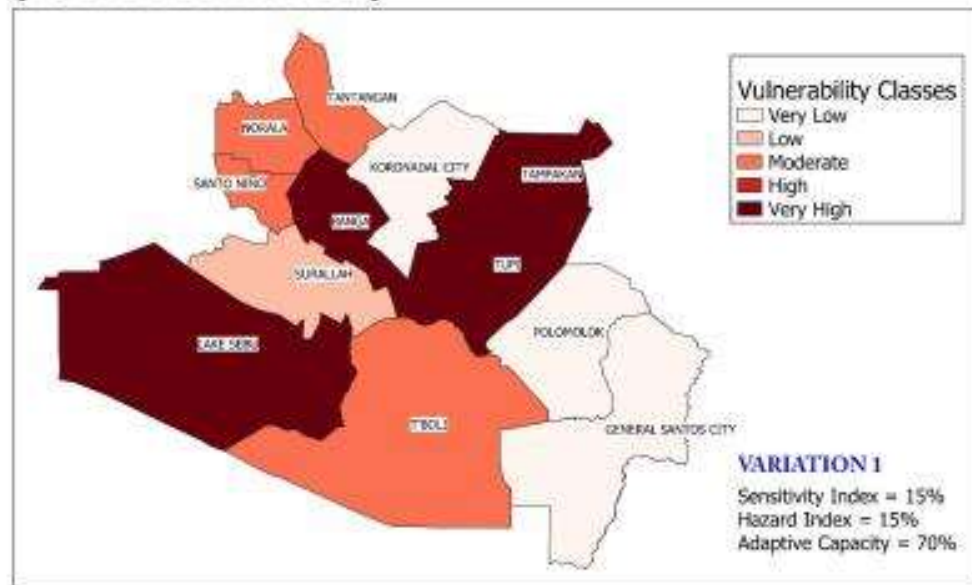
PROVINCE OF SOUTH COTABATO (VULNERABILITY MAP)



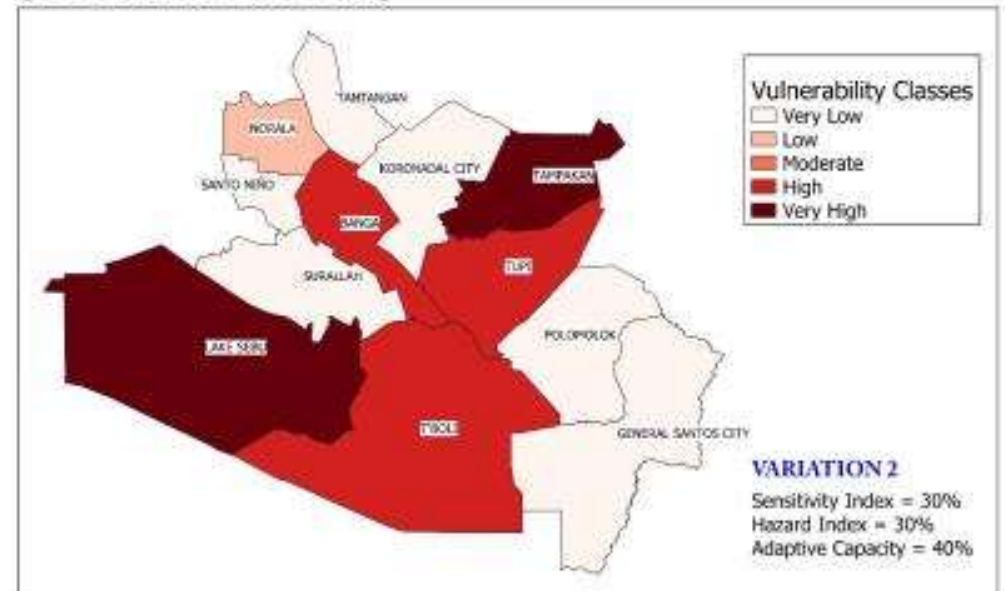
PROVINCE OF SOUTH COTABATO (VULNERABILITY MAP)



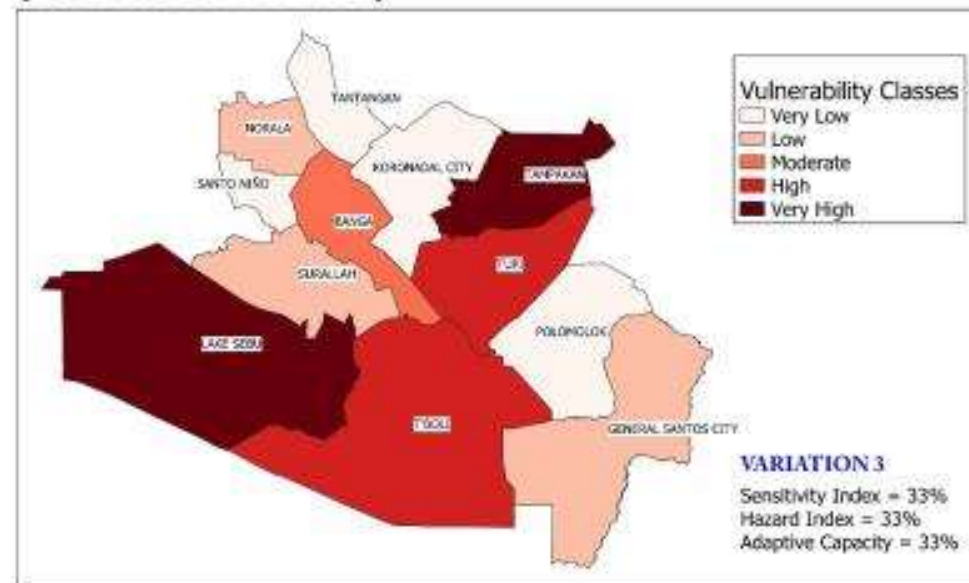
**PROVINCE OF SOUTH COTABATO
(VULNERABILITY MAP)**



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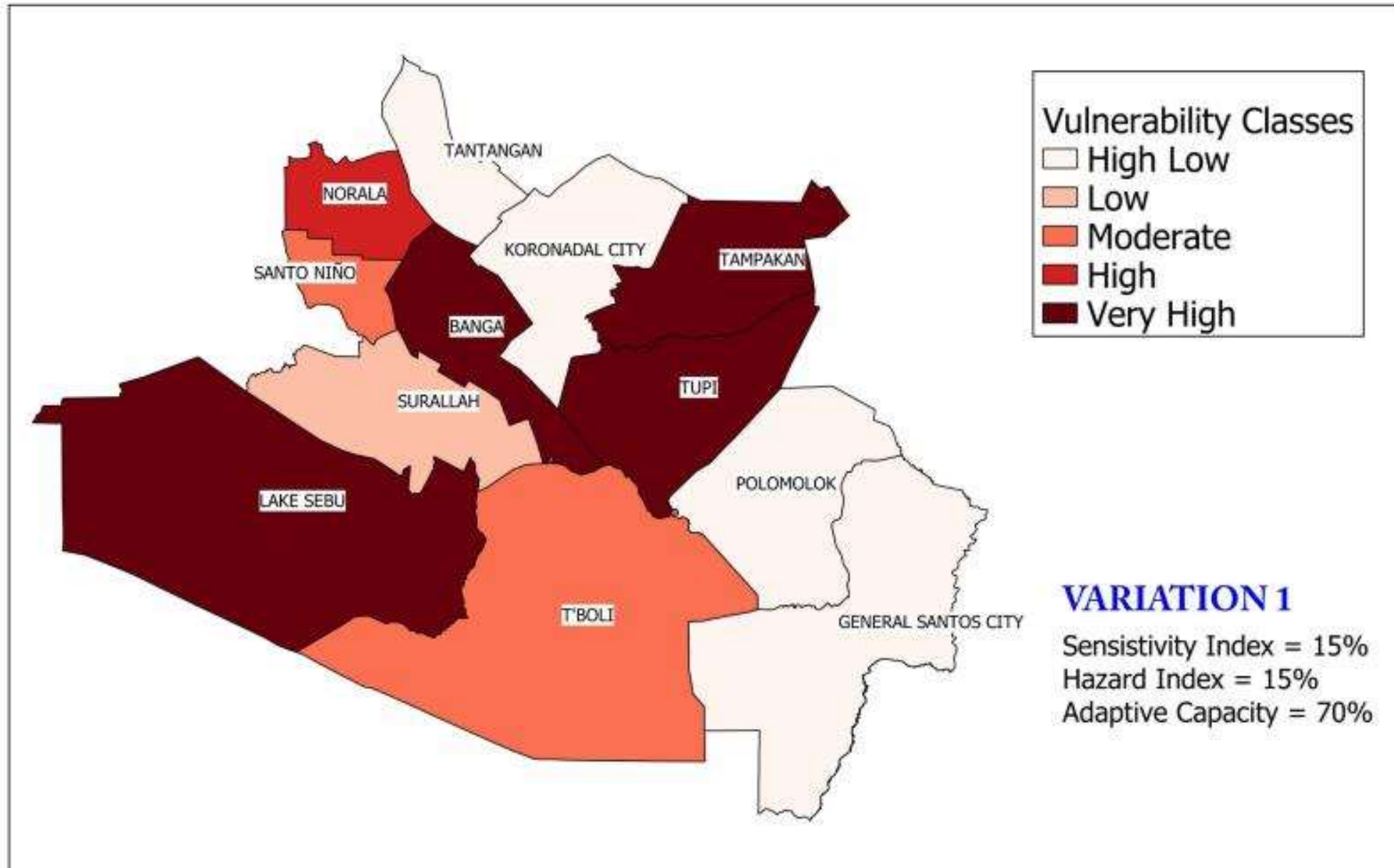


RICE

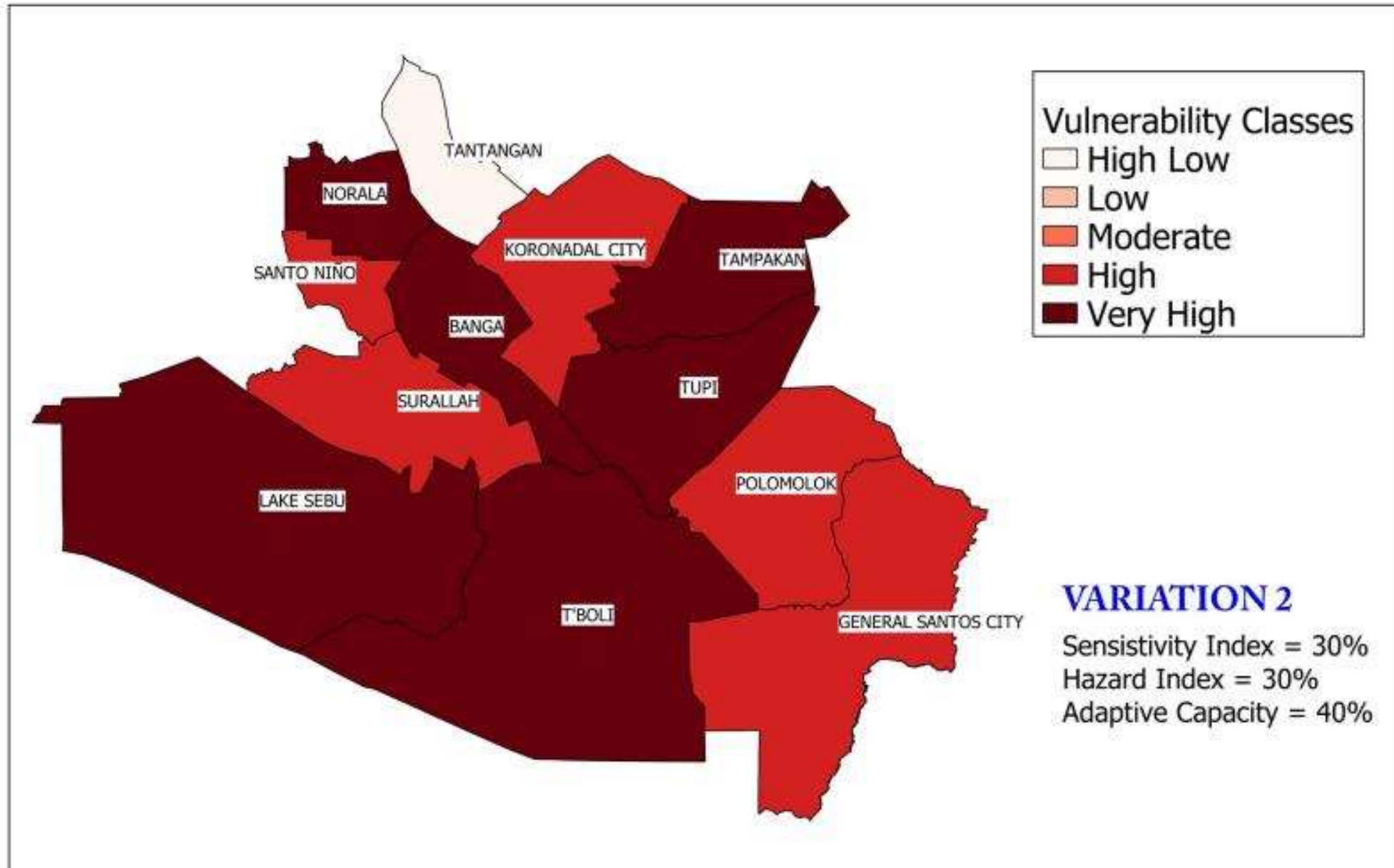
COMMODIT

Y

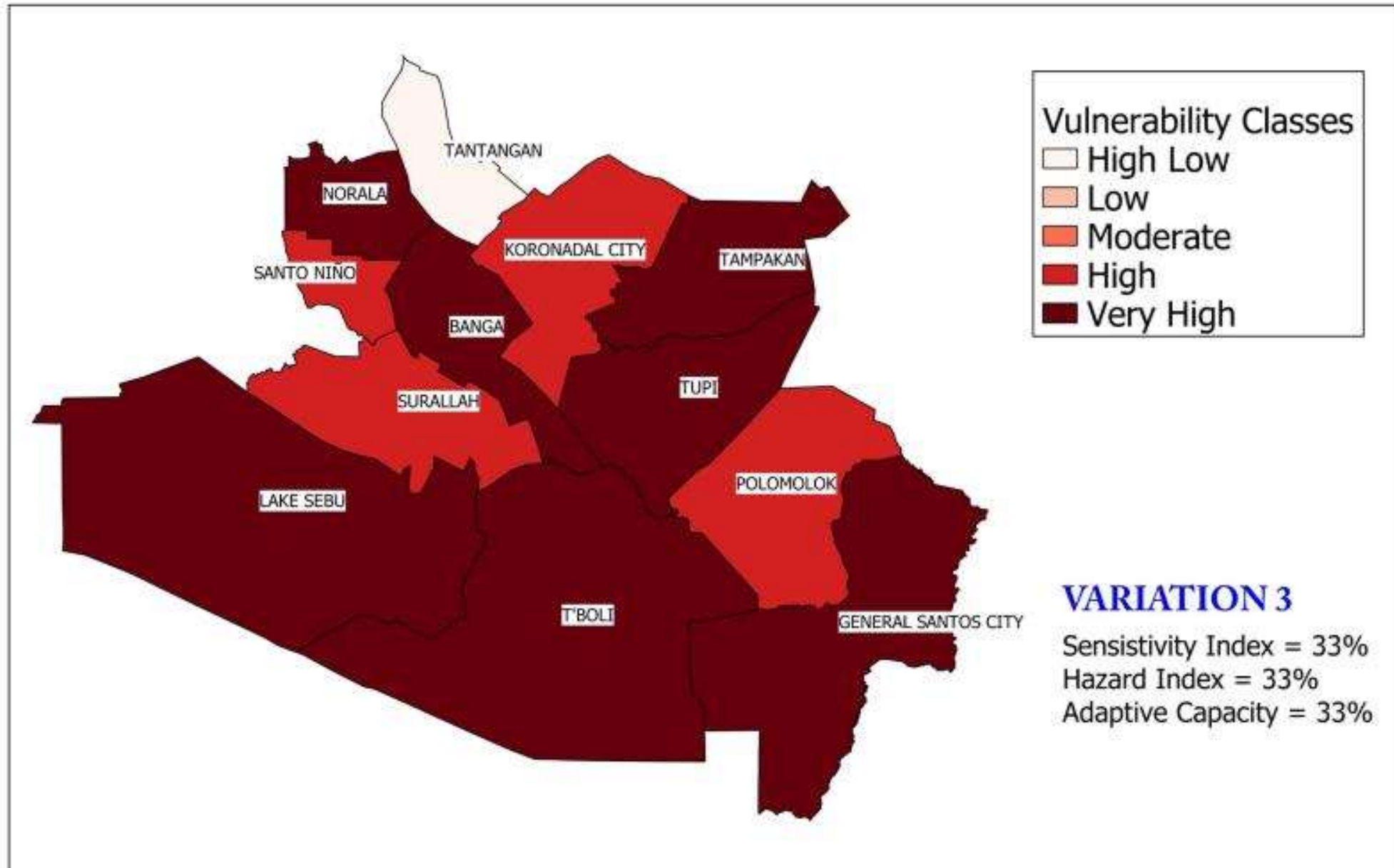
PROVINCE OF SOUTH COTABATO (SENSITIVITY MAP FOR RICE COMMODITY)



PROVINCE OF SOUTH COTABATO (SENSITIVITY MAP FOR RICE COMMODITY)

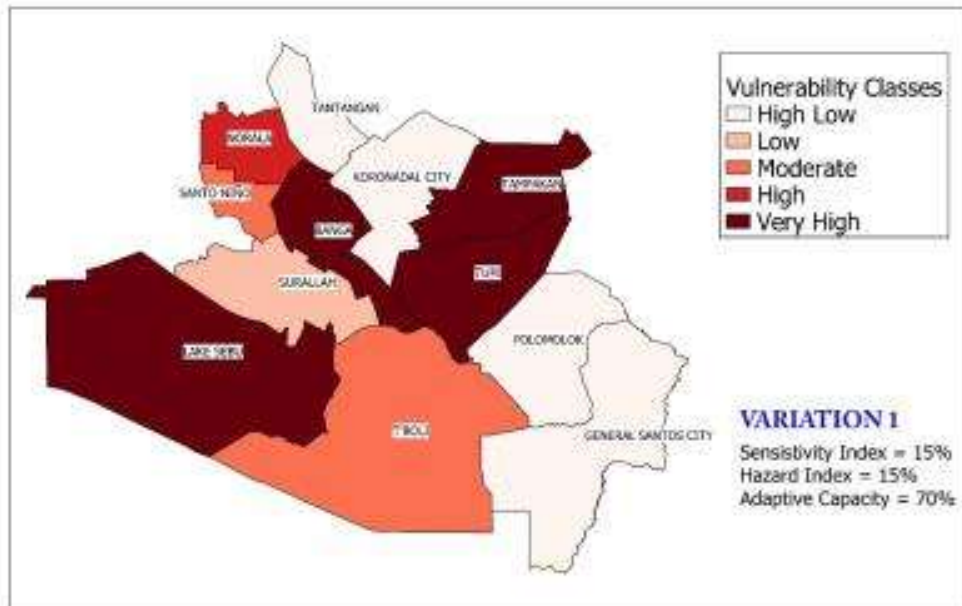


PROVINCE OF SOUTH COTABATO (SENSITIVITY MAP FOR RICE COMMODITY)

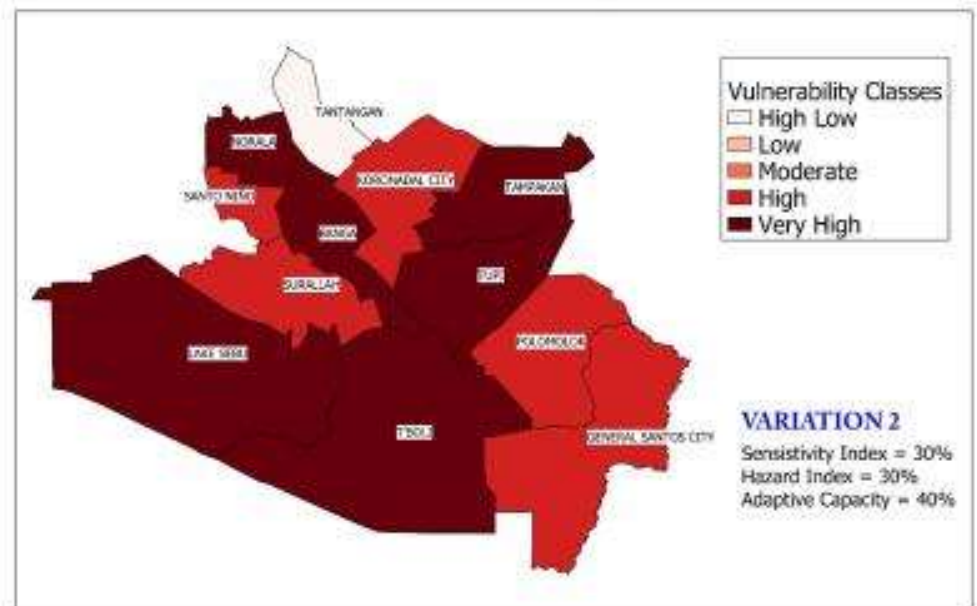


Mun_Name	Rice_V1_norm	Rice_V2_norm	Rice_V3_norm
BANGA	0.95	0.99	0.99
GENERAL SANTOS CITY	0.00	0.75	0.86
KORONADAL CITY	0.15	0.64	0.70
NORALA	0.68	0.84	0.85
POLOMOLOK	0.20	0.69	0.76
SURALLAH	0.33	0.75	0.80
TAMPAKAN	0.82	0.93	0.93
TANTANGAN	0.12	0.00	0.00
T'BOLI	0.52	0.85	0.90
TUPI	0.97	1.00	1.00
SANTO NIÑO	0.52	0.71	0.74
LAKE SEBU	1.00	1.00	0.99
1st			
2nd			
3rd			

**PROVINCE OF SOUTH COTABATO
(SENSITIVITY MAP FOR RICE COMMODITY)**



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(SENSITIVITY MAP FOR RICE COMMODITY)**



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(SENSITIVITY MAP FOR RICE COMMODITY)**

