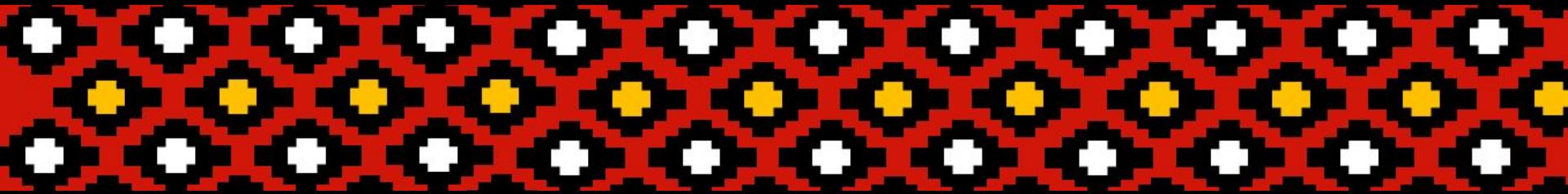


# **Barriers to Education:**



**Identifying key indicators to  
improve student retention in BARMM**



ARMM and its neighbor  
provinces reported a higher  
than average dropout rate  
in the country.

- Albert, David, Vizmanos, 2018





Source: <https://www.unicef.org/phippines/stories/every-child-bangsamoro-education>



Previous studies show that factors such as lack of interest and the rising cost of education make the students leave school.

- PSA 2016 Albert, David, Vizmanos





The schools in the region are also said to be vulnerable to conflict and crimes with 20% of all schools in the region reported having at least one incidence of armed conflict during the school year.

- David, Rappler 2017



Source: <https://www.rappler.com/thought-leaders/176773-education-spotlight-marawi>



*Disruptions to schooling caused by lack of interest, cost of education, access to basic needs, displacement, and conflict may result in declines in student attendance, and eventually student performance as well.*

# OBJECTIVES

Factors have been already identified in the previous studies, but policymakers and stakeholders also need to know where and how to set their priorities in improving student retention rates. With these, we aim to provide the following:

| MODEL  | 01 | 02 | MAP  |
|--|----|----|--|
| which will predict dropout rates per granularity of barangay and will identify the key factor causing the dropout. |    |    | that will provide as a storytelling guide for data communication and policy translation. |

# DATA SOURCES

## Open Bangsamoro

### DESCRIPTION

The OpenBangsamoro initiative supports the use of open statistical, geospatial, and administrative data for transparent, accountable, and participatory decision-making as the Autonomous Region in Muslim Mindanao (ARMM) transforms into the Bangsamoro Autonomous Region in Muslim Mindanao.

### RELEVANT FIELDS

### YEAR

2015 - 2019

## FLEMMS 2015

The Functional Literacy, Education and Mass Media Survey (FLEMMS) is a survey conducted by the National Statistics Office (NSO) every five years. It presents comprehensive statistics on the latest status of literacy, education, and mass media exposure of Filipinos.

Reference for geographical boundaries, coordinates and official list of barangays included in BARMM, number of schools and school age working population.

2015

## Department of Health

DOH provides a list of all existing Rural Health Units and Health Facilities across the country.

Reference for household data like house ownership and type, access to treated water and electricity, and OFW family member, individual data on school attendance and features.

2016 - 2018

## ACLED

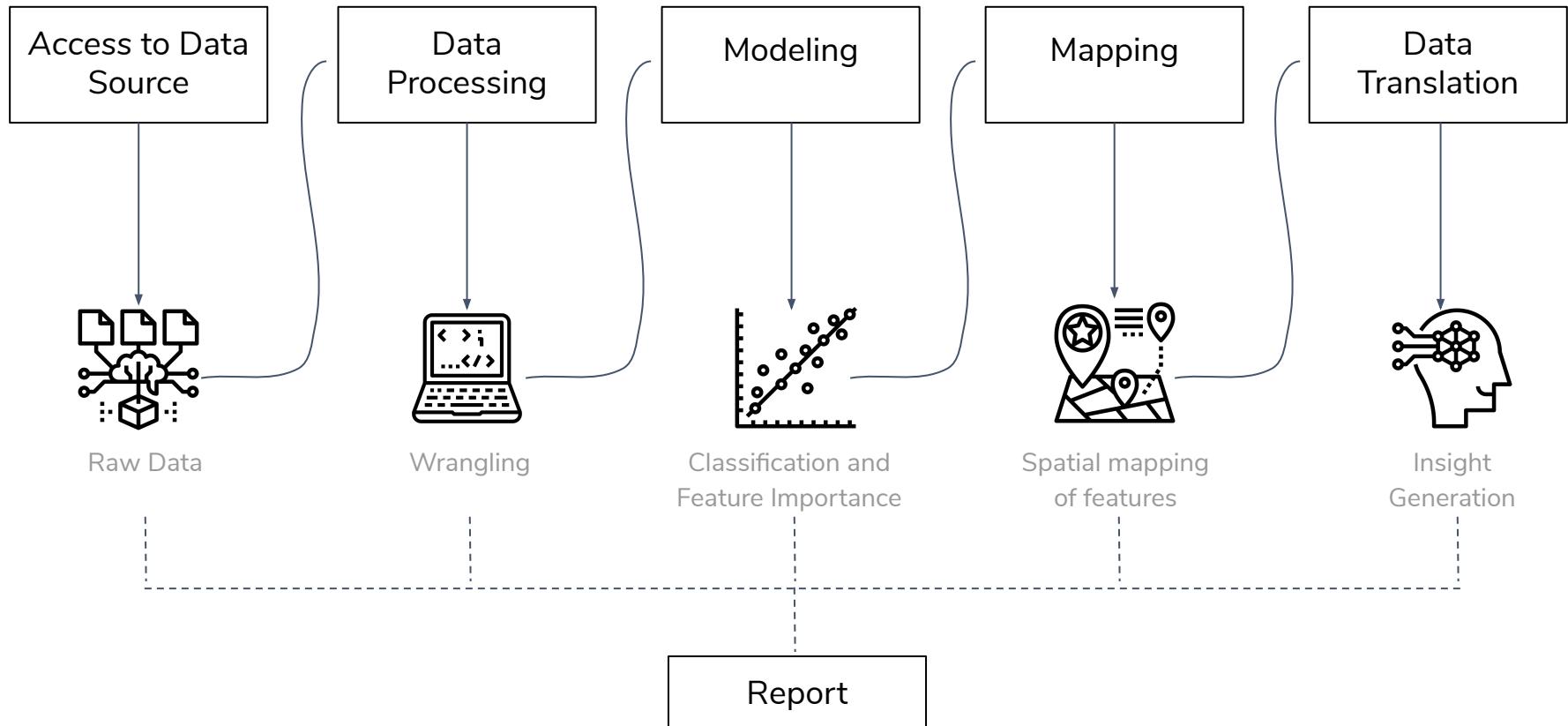
The Armed Conflict Location & Event Data Project (ACLED) is a disaggregated data collection, analysis, and crisis mapping project. ACLED records the dates, actors, types of violence, locations, and fatalities of all reported political violence and protest events across the world.

Reference for counts of health facilities and rural health units per barangay.

2016 - 2019

Reference for tagging (1, 0) a barangay if an armed conflict (based from ACLED categories) occurred within the Municipal vicinity.

# METHODOLOGY



# FEATURE ENGINEERING

Counts

Number of Health Facility

Number of High Schools

Number of Elementary Schools and Below

Binary

Occurrence of Armed Conflict

Nearest Distance

Distance to nearest health facility

Variable of Interest

School Attendance after Grade 3 (6 - 24 yo)

PROPORTIONS

Household with Concrete Walls Proportion

Access to Electricity Proportion

Access to Treated Water Proportion

Owned House and Lot Proportion

Has Copy Birth Certificate Proportion 6 - 24 yo

Married Proportion 6 - 24 yo

Overseas Worker in Family Proportion

Percentage of working 15 - 19 yo



# SPECIAL NOTES ON FEATURES

## Distance to nearest health facility

Centroid of each barangay was obtained and the euclidean distance to the nearest health facility was calculated

## School Attendance after Grade 3 (6-24 yo)

School age from literature is declared as 6 to 24 year old. From the demographics most of these ages finish up to Grade 3. Thus Grade 4 and above are considered for the school retention study. For modeling, the continuous values were discretized using quartiles.

## Occurrence of Armed Conflict

Data from media was used to match an armed conflict event to a town in the area. If a town was mentioned where an event occurred, all the barangays are tagged as 1 and 0 otherwise.

## Features of Proportion

Two levels are considered for proportions: household and individual. For the household level, a household is tagged as 1 if the condition holds then the mean is obtained per barangay. For the individual level, if the condition true than it is counted as one and the average is calculated per barangay.



# RESULTS



# Feature Correlations

|   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| School Attendance after Grade 3 (6 - 24 yo)     | 1.00  | 0.11  | -0.01 | 0.28  | 0.30  | 0.09  | 0.12  | 0.35  | -0.02 | 0.15  | 0.05  | -0.45 | 0.09  | 0.01  |
| Number of Health Facility                       | 0.11  | 1.00  | 0.02  | 0.02  | 0.07  | 0.08  | -0.13 | 0.22  | 0.06  | 0.12  | -0.06 | 0.00  | 0.24  | 0.22  |
| Occurrence of Armed Conflict                    | -0.01 | 0.02  | 1.00  | -0.09 | -0.14 | -0.00 | -0.02 | 0.07  | 0.02  | -0.02 | -0.03 | -0.03 | -0.04 | 0.01  |
| Household with Concrete Walls Proportion        | 0.28  | 0.02  | -0.09 | 1.00  | 0.50  | 0.07  | 0.16  | -0.01 | -0.06 | 0.00  | 0.47  | -0.26 | 0.13  | -0.01 |
| Access to Electricity Proportion                | 0.30  | 0.07  | -0.14 | 0.50  | 1.00  | 0.13  | 0.11  | 0.02  | 0.02  | 0.03  | 0.37  | -0.20 | 0.06  | -0.03 |
| Access to Treated Water Proportion              | 0.09  | 0.08  | -0.00 | 0.07  | 0.13  | 1.00  | -0.01 | 0.02  | 0.03  | -0.08 | 0.13  | -0.07 | 0.07  | -0.02 |
| Owned House and Lot Proportion                  | 0.12  | -0.13 | -0.02 | 0.16  | 0.11  | -0.01 | 1.00  | 0.04  | -0.16 | -0.17 | -0.01 | -0.21 | -0.04 | -0.03 |
| Has Copy Birth Certificate Proportion 6 - 24 yo | 0.35  | 0.22  | 0.07  | -0.01 | 0.02  | 0.02  | 0.04  | 1.00  | -0.06 | 0.19  | -0.37 | -0.19 | 0.05  | 0.10  |
| Married Proportion 6 - 24 yo                    | -0.02 | 0.06  | 0.02  | -0.06 | 0.02  | 0.03  | -0.16 | -0.06 | 1.00  | 0.07  | 0.06  | 0.13  | 0.02  | 0.02  |
| Overseas Worker in Family Proportion            | 0.15  | 0.12  | -0.02 | 0.00  | 0.03  | -0.08 | -0.17 | 0.19  | 0.07  | 1.00  | -0.12 | 0.05  | 0.04  | 0.04  |
| Distance to nearest health facility             | 0.05  | -0.06 | -0.03 | 0.47  | 0.37  | 0.13  | -0.01 | -0.37 | 0.06  | -0.12 | 1.00  | -0.12 | 0.03  | -0.16 |
| Percentage of working 15 - 19 yo                | -0.45 | 0.00  | -0.03 | -0.26 | -0.20 | -0.07 | -0.21 | -0.19 | 0.13  | 0.05  | -0.12 | 1.00  | -0.02 | 0.06  |
| Number of High Schools                          | 0.09  | 0.24  | -0.04 | 0.13  | 0.06  | 0.07  | -0.04 | 0.05  | 0.02  | 0.04  | 0.03  | -0.02 | 1.00  | 0.47  |
| Number of Elementary Schools and Below          | 0.01  | 0.22  | 0.01  | -0.01 | -0.03 | -0.02 | -0.03 | 0.10  | 0.02  | 0.04  | -0.16 | 0.06  | 0.47  | 1.00  |

# Feature Correlations

Sparse relation can be observed from the correlation of the features.

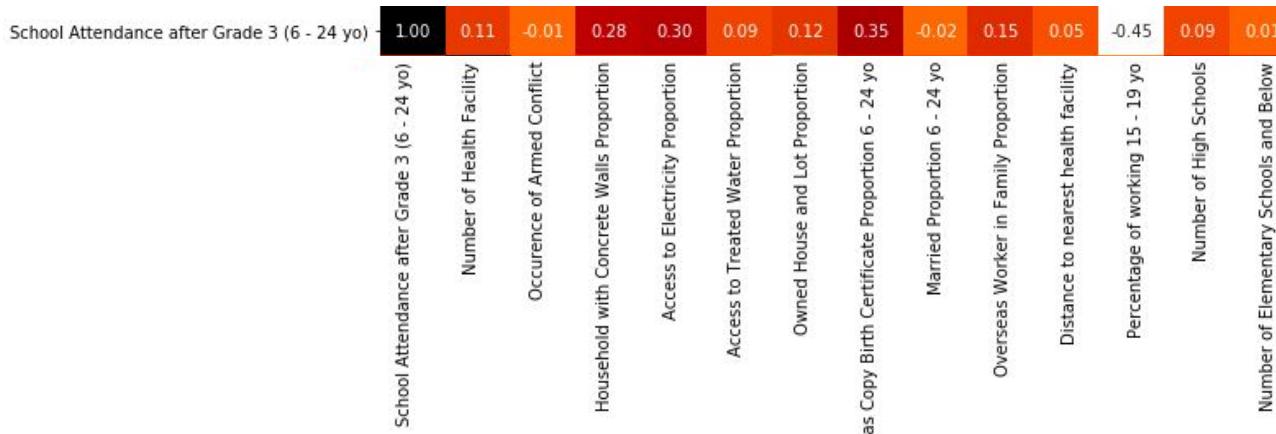
|   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| School Attendance after Grade 3 (6 - 24 yo)     | 1.00  | 0.11  | -0.01 | 0.28  | 0.30  | 0.09  | 0.12  | 0.35  | -0.02 | 0.15  | 0.05  | -0.45 | 0.09  | 0.01  |
| Number of Health Facility                       | 0.11  | 1.00  | 0.02  | 0.02  | 0.07  | 0.08  | -0.13 | 0.22  | 0.06  | 0.12  | -0.06 | 0.00  | 0.24  | 0.22  |
| Occurrence of Armed Conflict                    | -0.01 | 0.02  | 1.00  | -0.09 | -0.14 | -0.00 | -0.02 | 0.07  | 0.02  | -0.02 | -0.03 | -0.03 | -0.04 | 0.01  |
| Household with Concrete Walls Proportion        | 0.28  | 0.02  | -0.09 | 1.00  | 0.50  | 0.07  | 0.16  | -0.01 | -0.06 | 0.00  | 0.47  | -0.26 | 0.13  | -0.01 |
| Access to Electricity Proportion                | 0.30  | 0.07  | -0.14 | 0.50  | 1.00  | 0.13  | 0.11  | 0.02  | 0.02  | 0.03  | 0.37  | -0.20 | 0.06  | -0.03 |
| Access to Treated Water Proportion              | 0.09  | 0.08  | -0.00 | 0.07  | 0.13  | 1.00  | -0.01 | 0.02  | 0.03  | -0.08 | 0.13  | -0.07 | 0.07  | -0.02 |
| Owned House and Lot Proportion                  | 0.12  | -0.13 | -0.02 | 0.16  | 0.11  | -0.01 | 1.00  | 0.04  | -0.16 | -0.17 | -0.01 | -0.21 | -0.04 | -0.03 |
| Has Copy Birth Certificate Proportion 6 - 24 yo | 0.35  | 0.22  | 0.07  | -0.01 | 0.02  | 0.02  | 0.04  | 1.00  | -0.06 | 0.19  | -0.37 | -0.19 | 0.05  | 0.10  |
| Married Proportion 6 - 24 yo                    | -0.02 | 0.06  | 0.02  | -0.06 | 0.02  | 0.03  | -0.16 | -0.06 | 1.00  | 0.07  | 0.06  | 0.13  | 0.02  | 0.02  |
| Overseas Worker in Family Proportion            | 0.15  | 0.12  | -0.02 | 0.00  | 0.03  | -0.08 | -0.17 | 0.19  | 0.07  | 1.00  | -0.12 | 0.05  | 0.04  | 0.04  |
| Distance to nearest health facility             | 0.05  | -0.06 | -0.03 | 0.47  | 0.37  | 0.13  | -0.01 | -0.37 | 0.06  | -0.12 | 1.00  | -0.12 | 0.03  | -0.16 |
| Percentage of working 15 - 19 yo                | -0.45 | 0.00  | -0.03 | -0.26 | -0.20 | -0.07 | -0.21 | -0.19 | 0.13  | 0.05  | -0.12 | 1.00  | -0.02 | 0.06  |
| Number of High Schools                          | 0.09  | 0.24  | -0.04 | 0.13  | 0.06  | 0.07  | -0.04 | 0.05  | 0.02  | 0.04  | 0.03  | -0.02 | 1.00  | 0.47  |
| Number of Elementary Schools and Below          | 0.01  | 0.22  | 0.01  | -0.01 | -0.03 | -0.02 | -0.03 | 0.10  | 0.02  | 0.04  | -0.16 | 0.06  | 0.47  | 1.00  |

# Correlations

## Deep-Dive

**Having a copy of Birth Certificate,  
Access to Electricity,  
Living in a concrete house,**

are positively correlated with school attendance.  
This can imply that high values of these features  
can result to an increase in school attendance.



# Correlations Deep-Dive

**Occurrence of Armed Conflict,  
High Proportion of Youth Marriage,  
High Proportion of Working Youth,**

are negatively correlated with school attendance. This implies that high values of these features may result to a decrease in school attendance.



# Correlations Deep-Dive

## Obvious Correlations

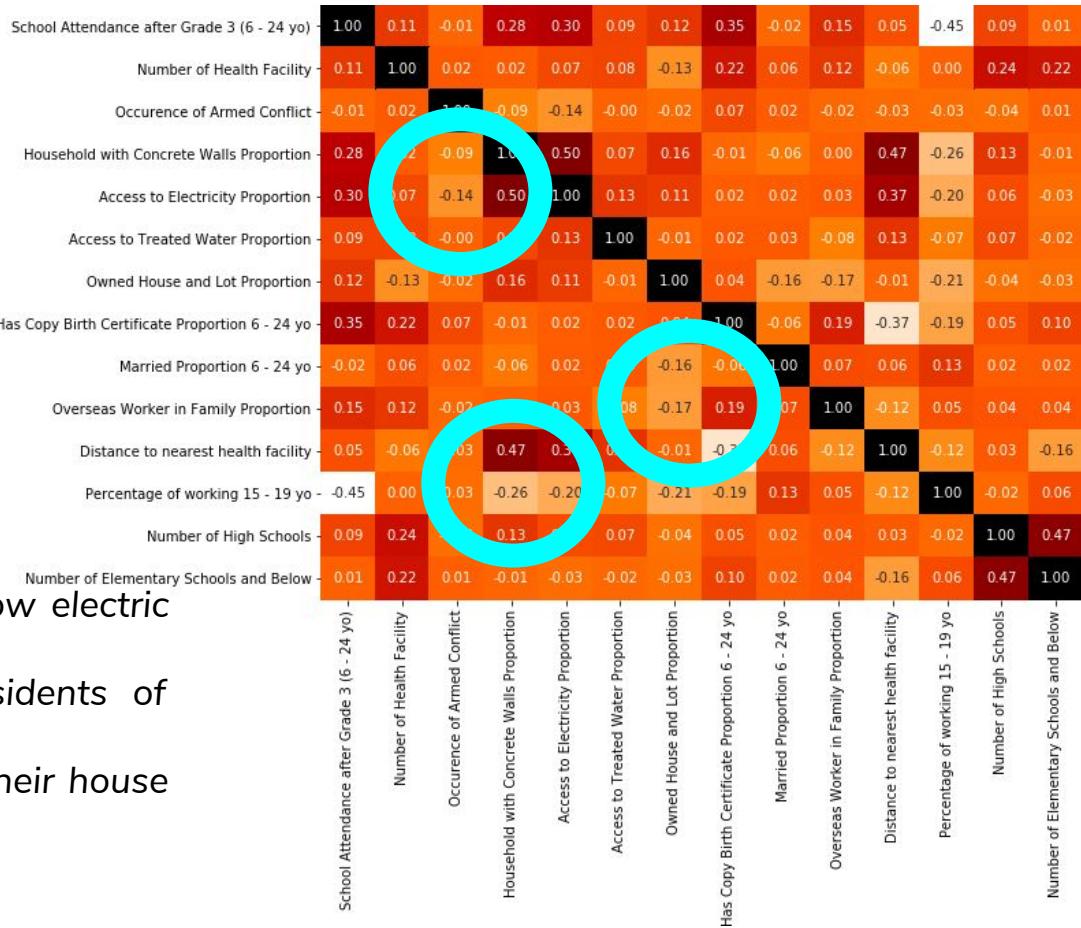
- A presence of an elementary school requires the presence a high school.
- Concrete houses are more likely to have access to electricity.
- Problems from birth certificates happen most likely because of the far distance of the barangay to a health facility.



# Correlations Deep-Dive

## Interesting Correlations

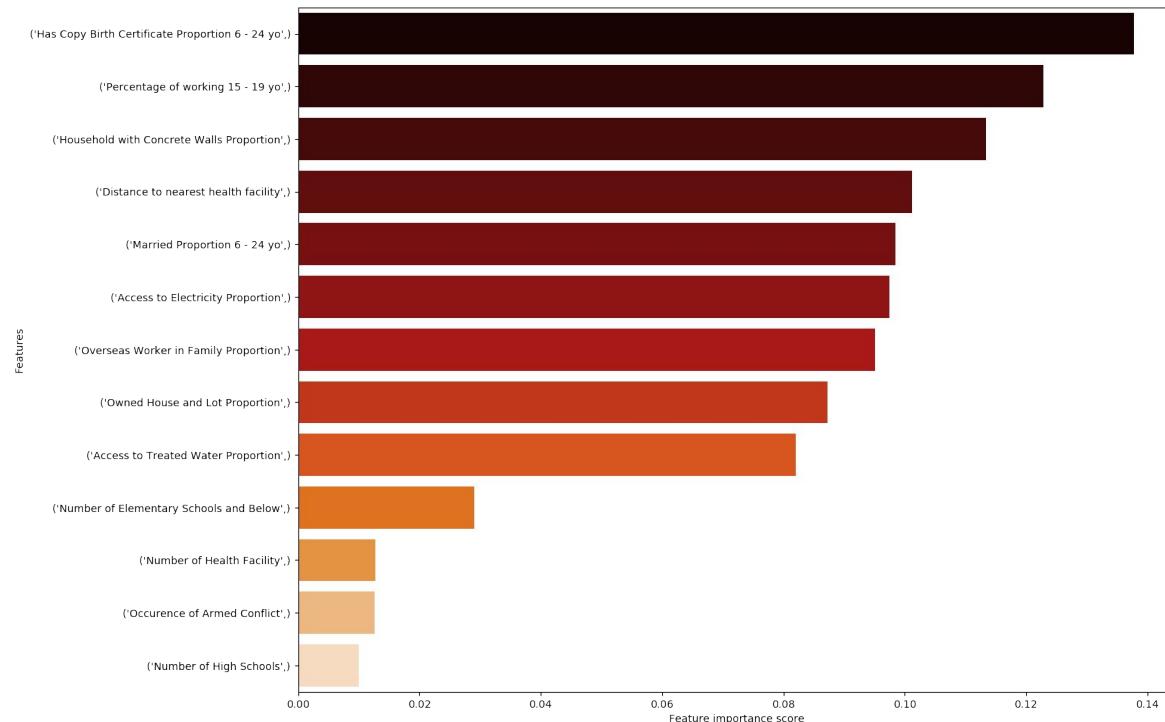
- Armed conflict also tend to occur on low electric penetration areas.
- Youth marriage is less likely for residents of concrete houses.
- OFW families don't usually own their house and lot.



# Feature Importance using Random Forest

In this study, we are interested in quantifying possible factors that affect school attendance. By using school attendance as a label, random forest feature importance was done with 1000 estimators for ranking the variables.

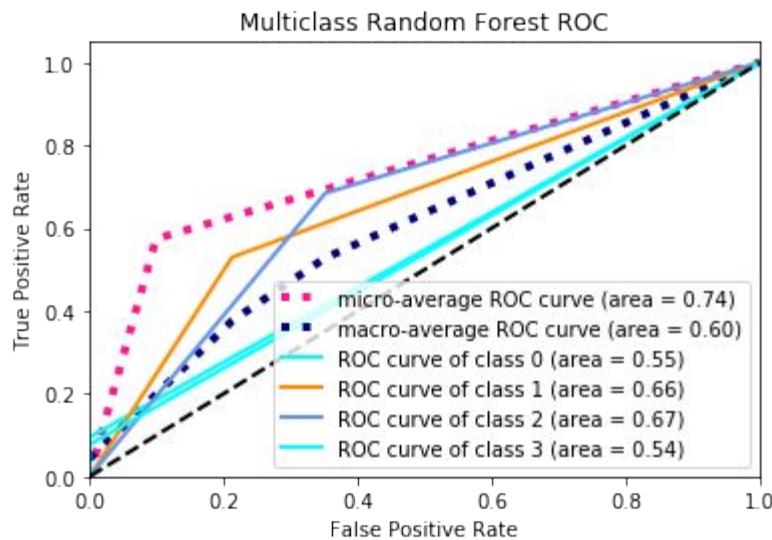




**Having a copy of Birth Certificate, Having an environment for youth labor, Living in concrete homes, are the top three indicators of school attendance.**

- Birth Certificates are documents required for school enrolment so it makes sense that availability of these affects school attendance.
- An environment for youth labor indicates low economic opportunities making studies less of an option.
- Living in concrete homes is an indicator of capacity to spend on basic needs and on education.

# Model Performance



| Model                                   | Accuracy | Precision |
|---|----------|-----------|
| Random Forest Classifier with 100 trees | 64.22    | 64.65     |

Classification was done to model school attendance (label) based on previous features. Random forest was used to predict the actual label given the features. Accuracy and precision values indicate that the model predicts the state of school attendance around 65% of the time. This can be improved by adding more data points, testing out more features, and considering other models.

# CONCLUSION

Education is an important indicator of having a developed state and productive citizens. But for the people in BARMM, education may be important but is not as urgent as the features suggest. We first need to recognize the basic needs of the people in order for them to have a decent way of living.

School-aged children also have other responsibilities in their community: they are also members of a family, a son, or a daughter. Education may not be the top priority for these children as there are more urgent things to address so they can survive the everyday life.

One would first think if there will be food to eat, shelter to protect them from conflict, and provision of health needs especially during emergencies. Improving student retention rates also means addressing these barriers first.



# RECOMMENDATIONS

Methodology-wise, future studies may add environment data and armed conflict information on the barangay level to better estimate the outcome. It would be also helpful to compare the findings to other models.

To address bureaucratic roadblocks, requirements needed for school admissions such as birth certificates and the like must be made accessible to the people.

On the policy-side, it is important to acknowledge the current context of BARMM. We cannot just provide an education system that works in other regions and expect them to adapt to it. Further studies on social, economic, and cultural context should be conducted to come up with a more appropriate education system for BARMM.



# BIVARIATE CHOROPLETH MAPS PER FEATURE PER REGION



The maps are intended to identify priority areas based on features.

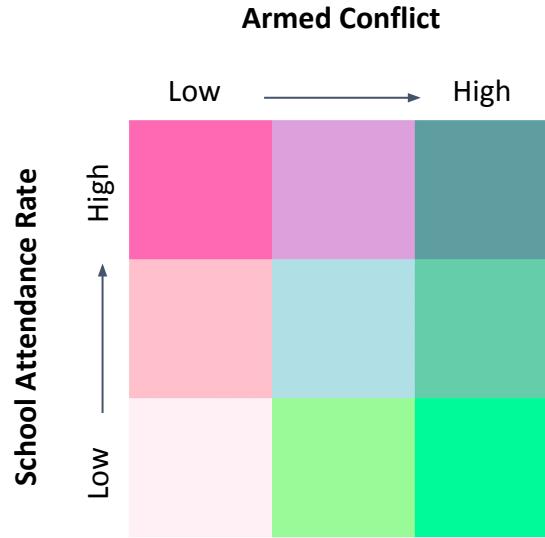


# BIVARIATE MAP GUIDE

By combining different sets of colors, bivariate mapping allows for the representation of multiple variables simultaneously on a single map.

These variables are categorized into discrete rankings, and different ranking combinations for any set of variables gives a unique color.

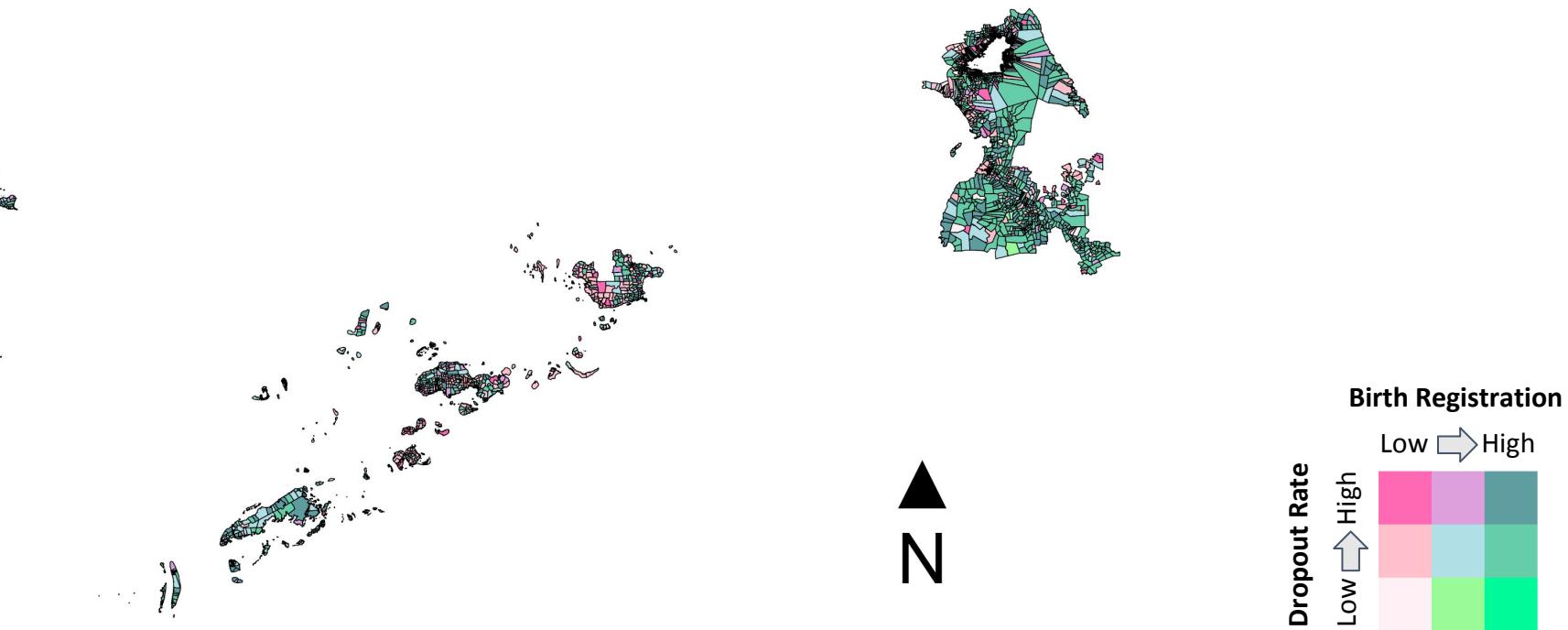
Such representation can be a more effective graphical method of revealing relationships between a set of phenomena. For example, a high attendance rate and low armed conflict is represented as dark pink, as shown in the figure.



# BIRTH REGISTRATION

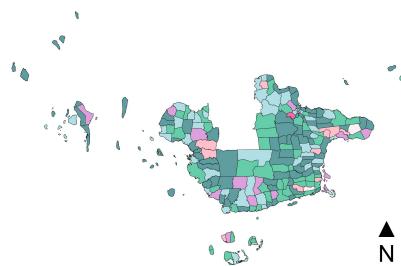


# BIRTH REGISTRATION IN BARMM

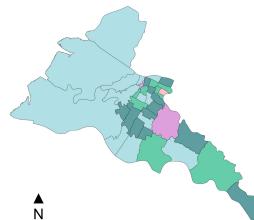


# BIRTH REGISTRATION

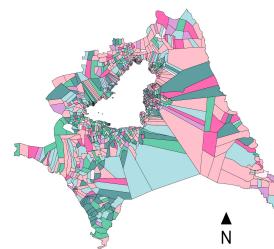
BASILAN



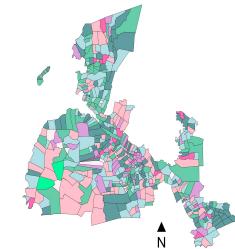
COTABATO CITY



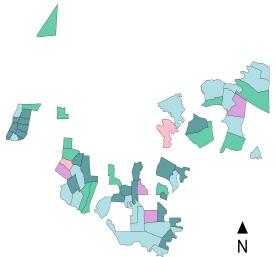
LANAO



MAGUINDANAO



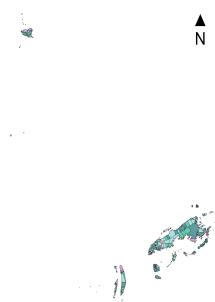
NORTH COTABATO



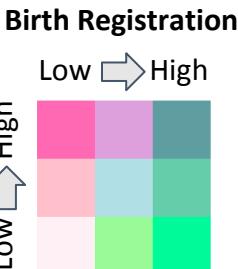
SULU



TAWI-TAWI



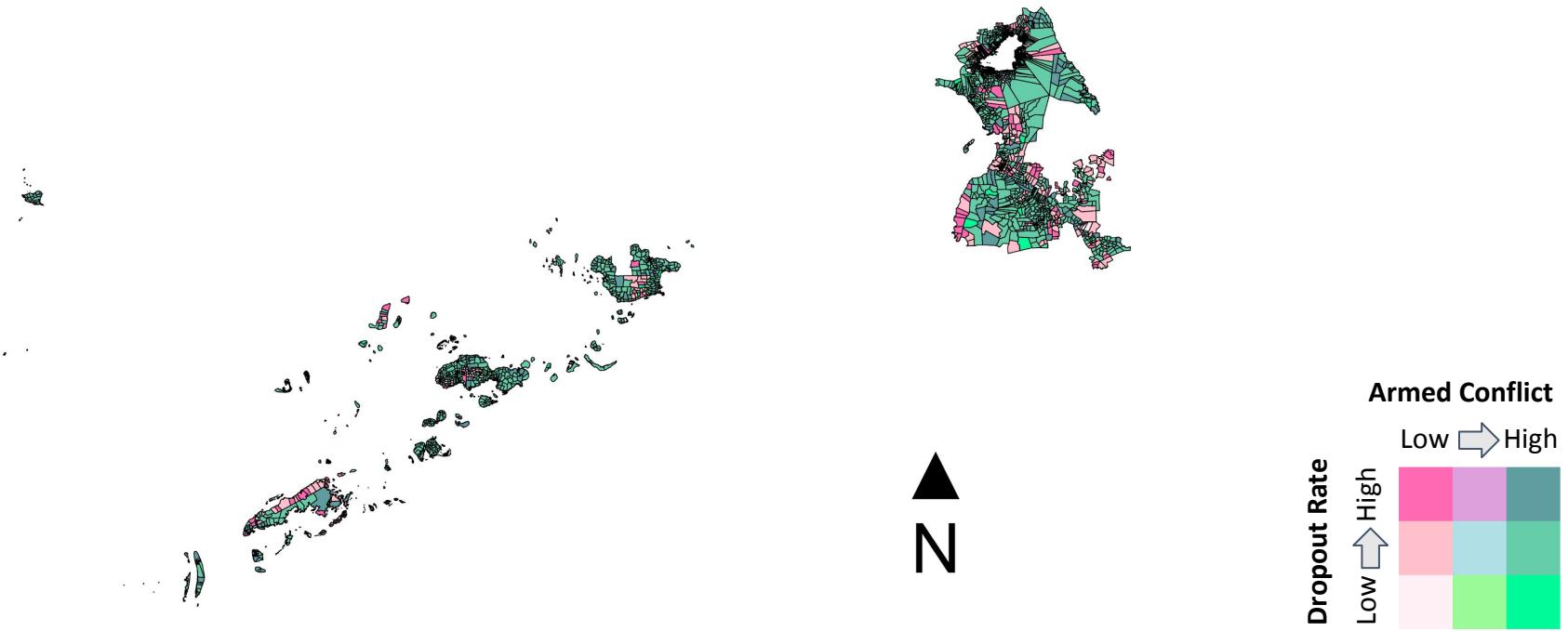
Dropout Rate



# ARMED CONFLICT

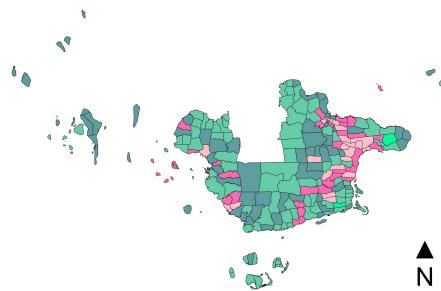


# ARMED CONFLICT IN BARMM

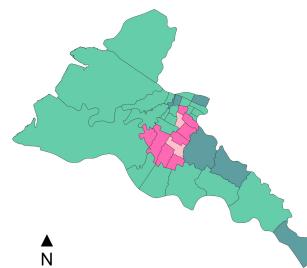


# ARMED CONFLICT

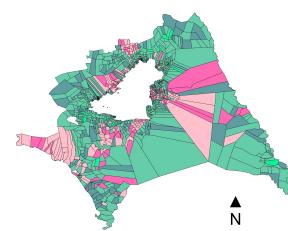
BASILAN



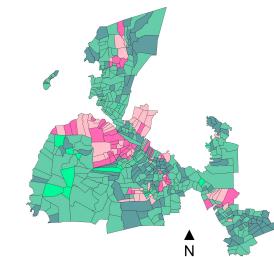
COTABATO CITY



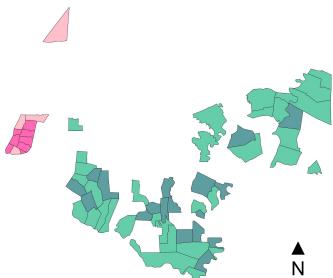
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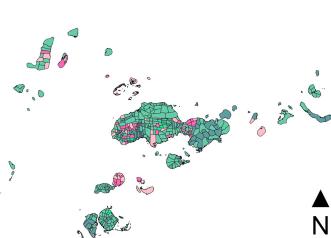
MAGUINDANAO



NORTH COTABATO



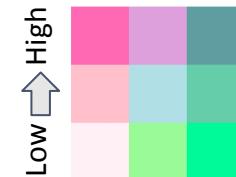
SULU



TAWI-TAWI



Dropout Rate



# HOUSEHOLD WITH CONCRETE WALLS



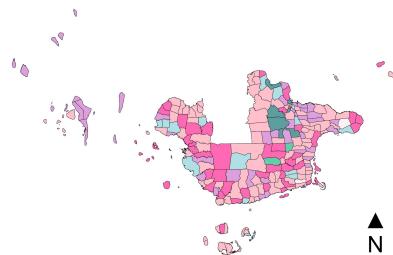
# HOUSEHOLD WITH CONCRETE WALLS IN BARMM

Household with Concrete Walls in BARMM

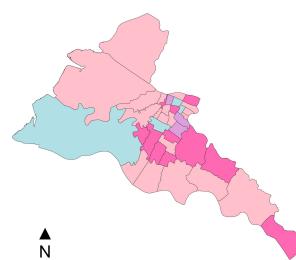


# HOUSEHOLD WITH CONCRETE WALLS IN BARMM

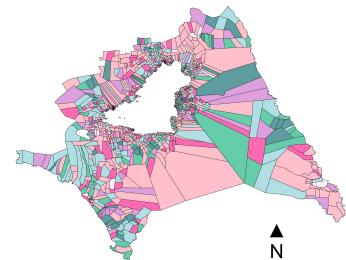
BASILAN



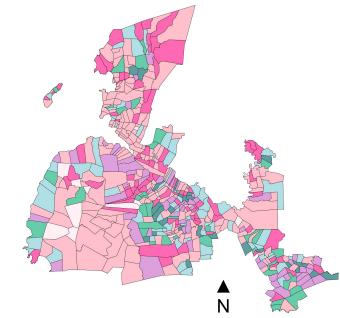
COTABATO CITY



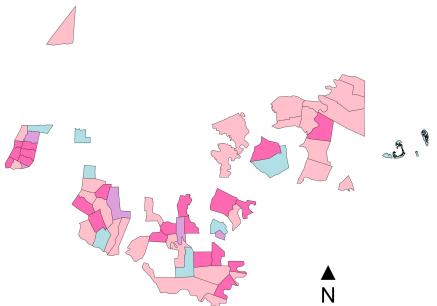
LANAO



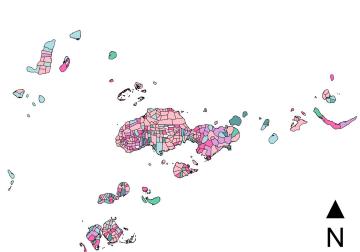
MAGUINDANAO



NORTH COTABATO



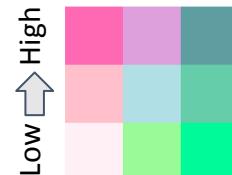
SULU



TAWI-TAWI



Dropout Rate



# ACCESS TO ELECTRICITY



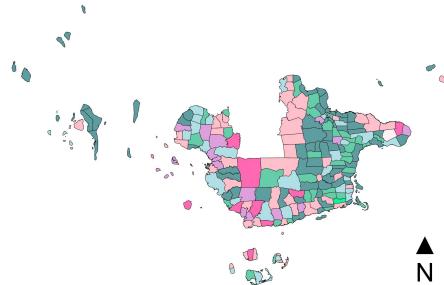
# ACCESS TO ELECTRICITY

Access to Electricity in BARMM

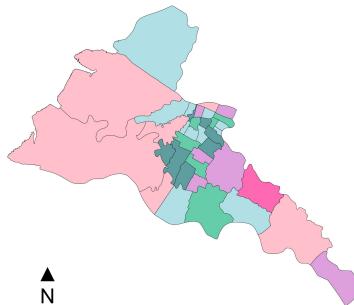


# ACCESS TO ELECTRICITY

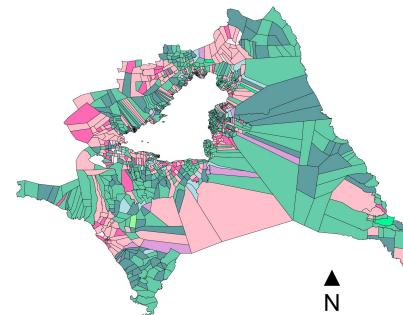
BASILAN



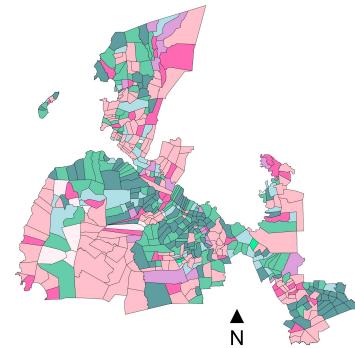
COTABATO CITY



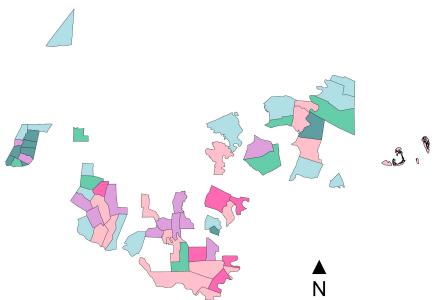
LANAO



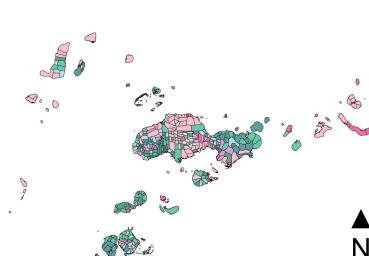
MAGUINDANAO



NORTH COTABATO



SULU



TAWI-TAWI



Dropout Rate

Low ↑ High



Feature

Low ↑ High

# NUMBER OF ELEMENTARY SCHOOLS



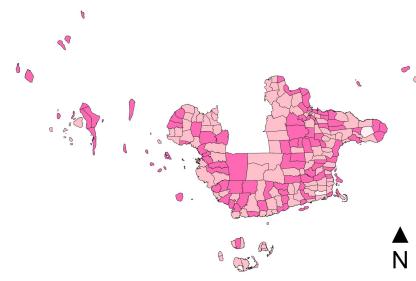
# NUMBER OF ELEMENTARY SCHOOLS IN BARMM

Number of Elementary Schools and Below in BARMM

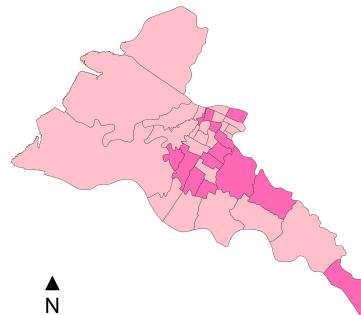


# NUMBER OF ELEMENTARY SCHOOLS IN BARMM

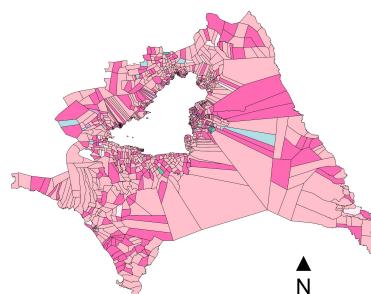
BASILAN



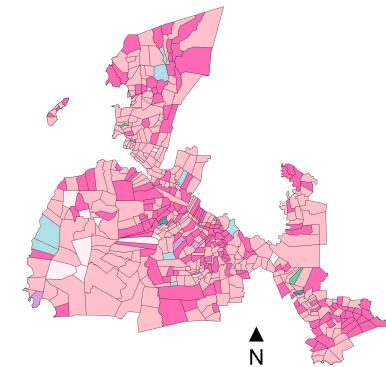
COTABATO CITY



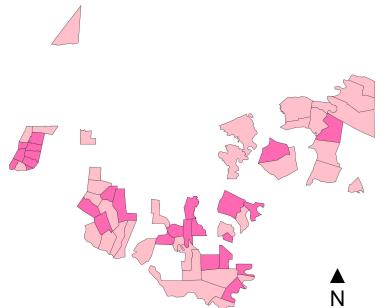
LANAO



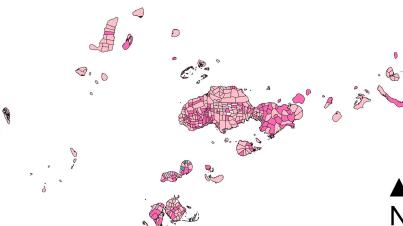
MAGUINDANAO



NORTH COTABATO



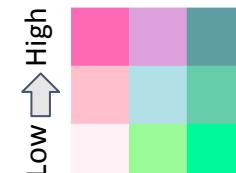
SULU



TAWI-TAWI



Dropout Rate



# NUMBER OF SECONDARY SCHOOLS



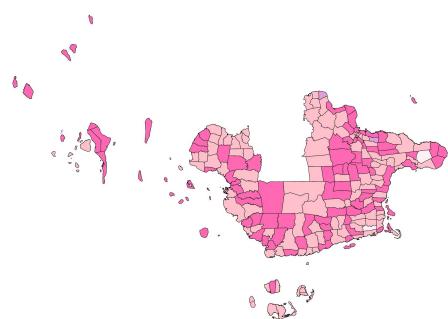
# NUMBER OF SECONDARY SCHOOLS IN BARMM

Number of High Schools in BARMM

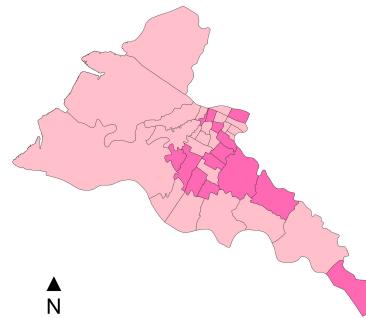


# NUMBER OF SECONDARY SCHOOLS IN BARMM

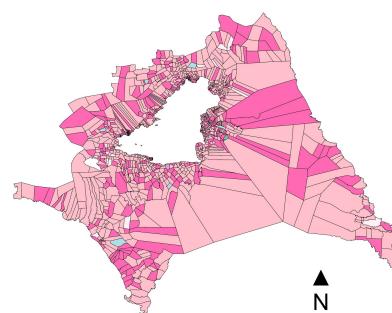
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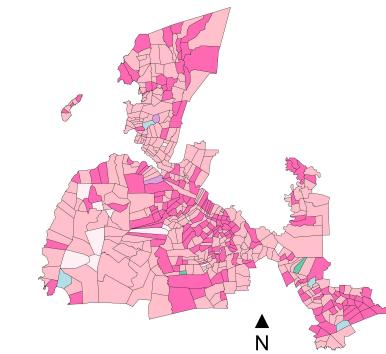
COTABATO CITY



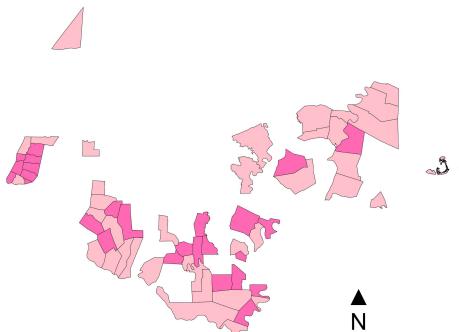
LANAO



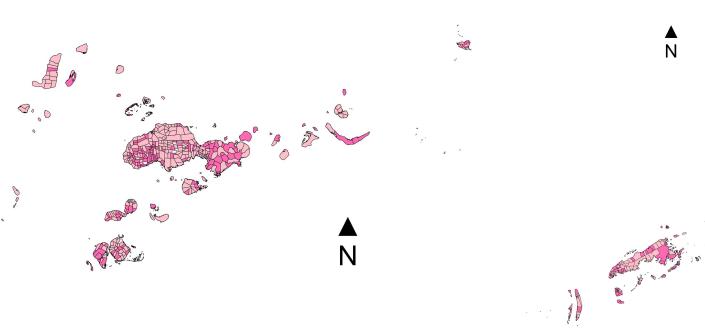
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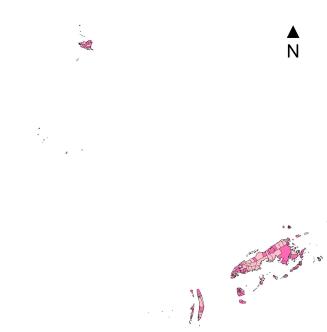
NORTH COTABATO



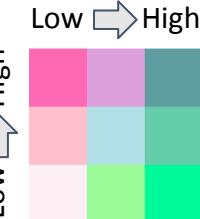
SULU



TAWI-TAWI



Dropout Rate  
Low ↑ High



# NEAREST HEALTH FACILITY



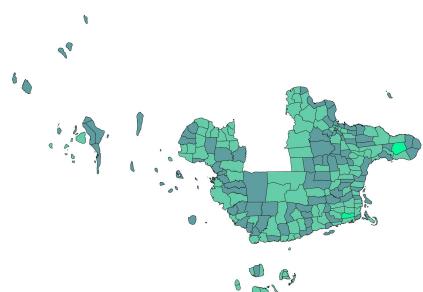
# NEAREST HEALTH FACILITY

Distance to Nearest Health Facility in BARMM

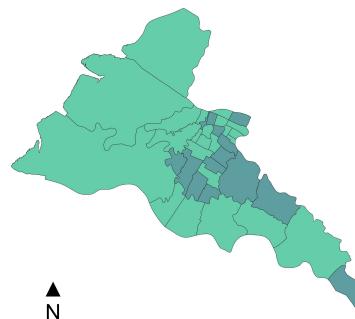


# NEAREST HEALTH FACILITY

BASILAN



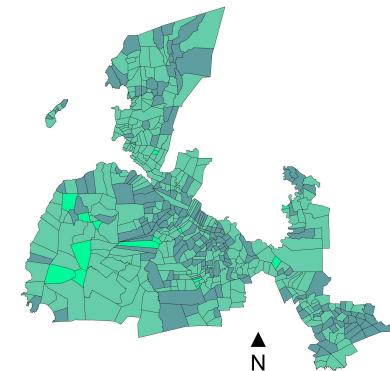
COTABATO CITY



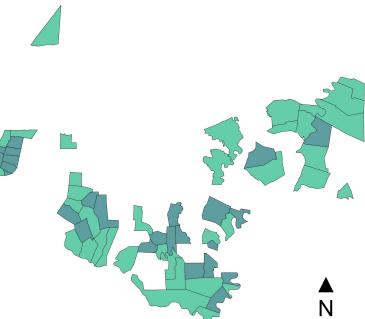
LANAO



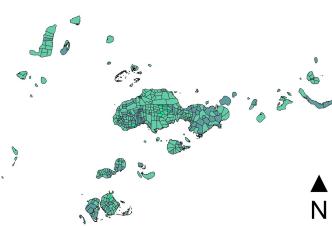
MAGUINDANAO



NORTH COTABATO



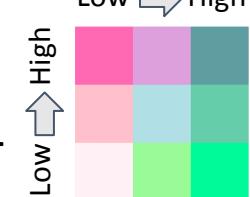
SULU



TAWI-TAWI



Dropout Rate



# EMPLOYMENT PERCENTAGE

15-19 yo



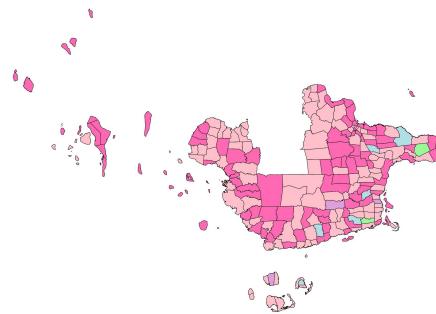
# EMPLOYMENT PERCENTAGE

Employment Percentage (15-19 yrs. old) in BARMM

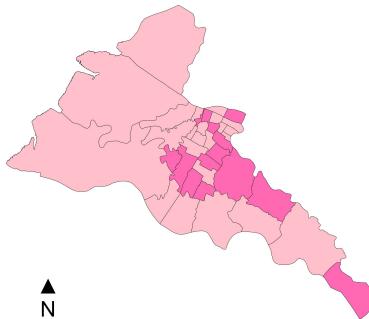


# EMPLOYMENT PERCENTAGE

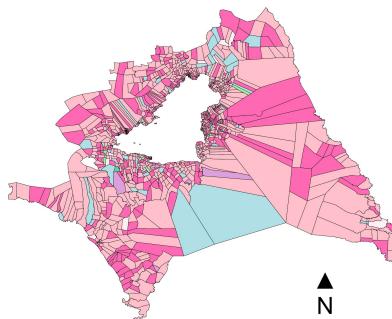
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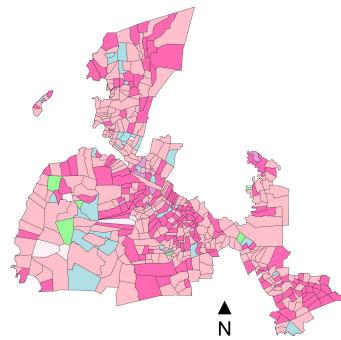
COTABATO CITY



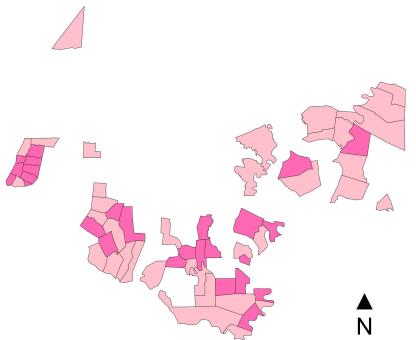
LANAO



MAGUINDANAO



NORTH COTABATO



SULU



TAWI-TAWI



Dropout Rate

Low ↑ High



Feature

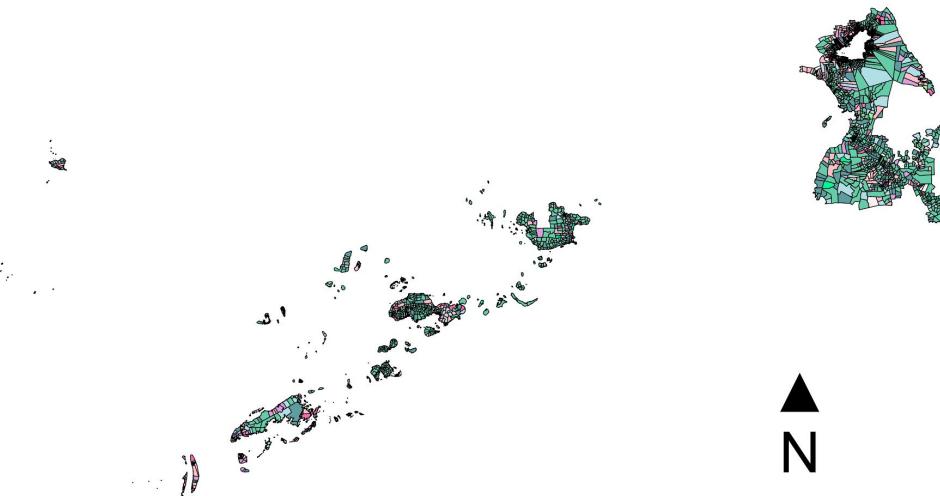
Low → High

# OWNED HOUSE AND LOT



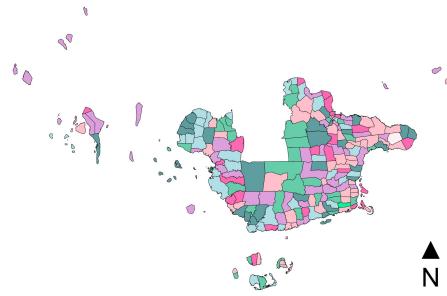
# OWNED HOUSE AND LOT

Owned House and Lot in BARMM

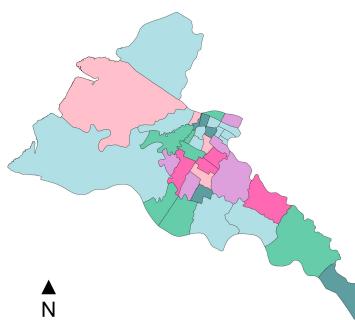


# OWNED HOUSE AND LOT

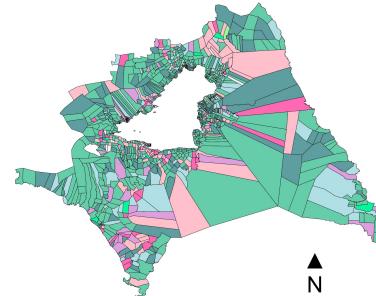
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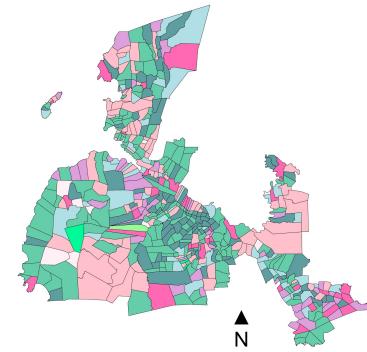
COTABATO CITY



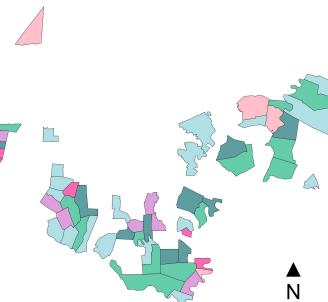
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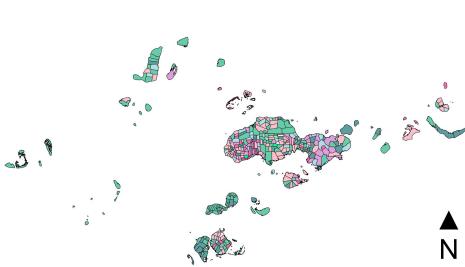
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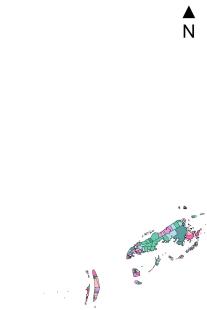
NORTH COTABATO



SULU



TAWI-TAWI



Dropout Rate

Low ↑ High



Feature

Low ↑ High

# MARRIAGE PROPORTION



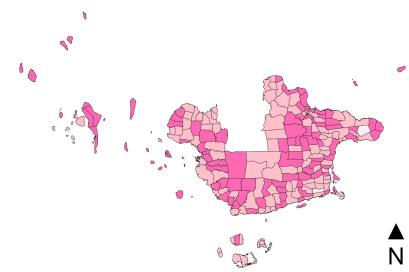
# MARRIAGE PROPORTION

Married Proportion (6-24 yrs. old) in BARMM

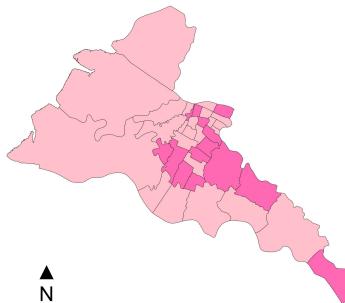


# MARRIAGE PROPORTION

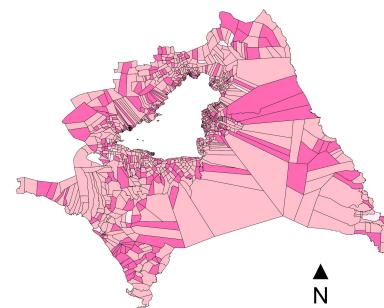
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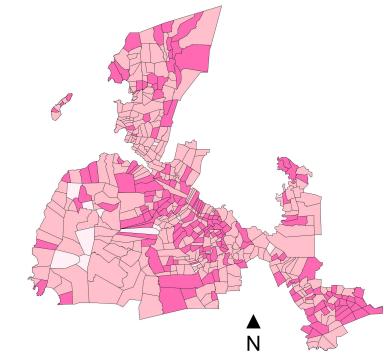
COTABATO CITY



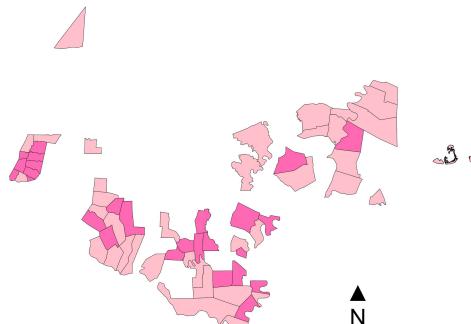
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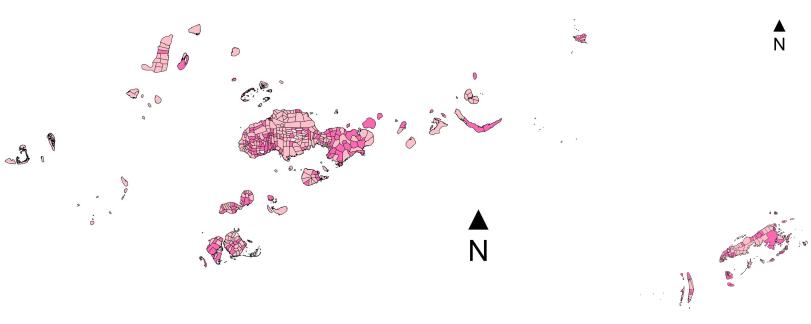
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NORTH COTABATO



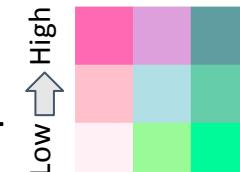
SULU



TAWI-TAWI



Dropout Rate



Feature

Low → High

# OFW WORKER IN FAMILY



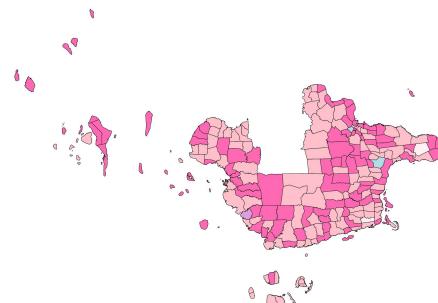
# OFW WORKER IN THE FAMILY

Overseas Worker in Family Proportion in BARMM

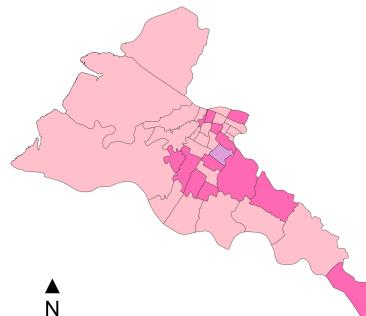


# OFW WORKER IN THE FAMILY

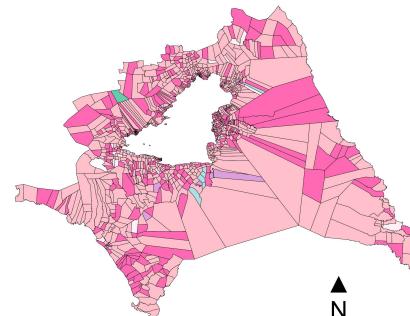
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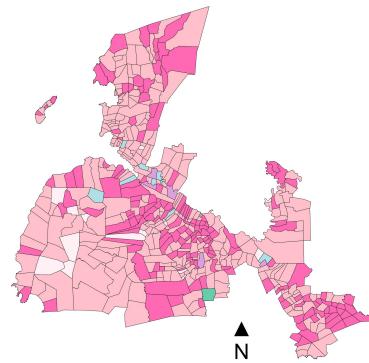
COTABATO CITY



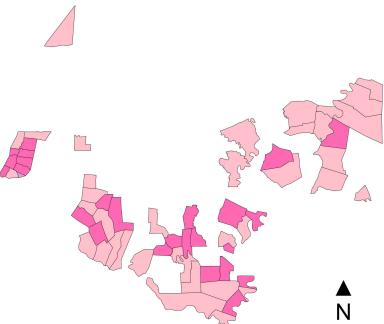
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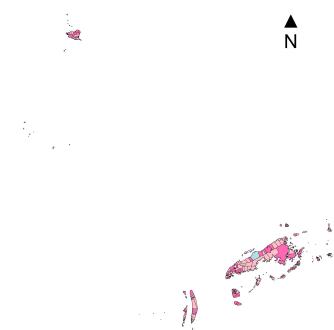
NORTH COTABATO



SULU



TAWI-TAWI



Dropout Rate

Low → High  
Low ↑ High



# ACCESS TO TREATED WATER



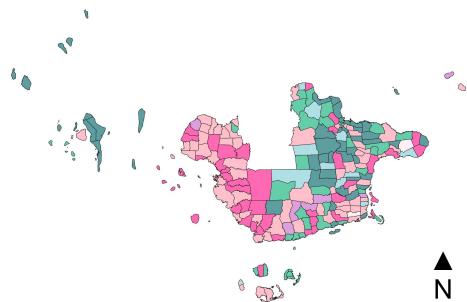
# ACCESS TO TREATED WATER

Access to Treated Water in BARMM

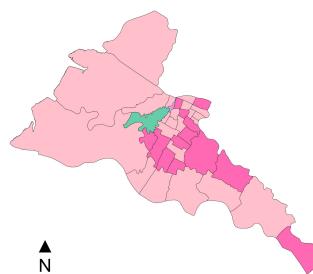


# ACCESS TO TREATED WATER

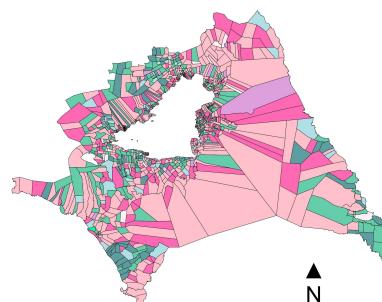
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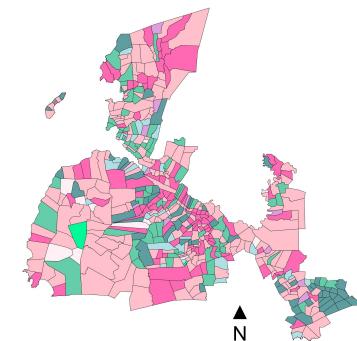
COTABATO CITY



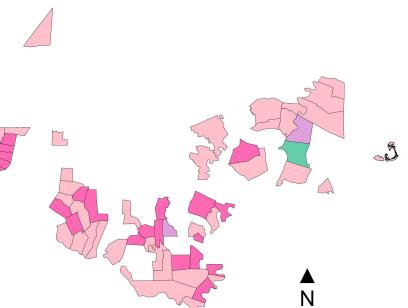
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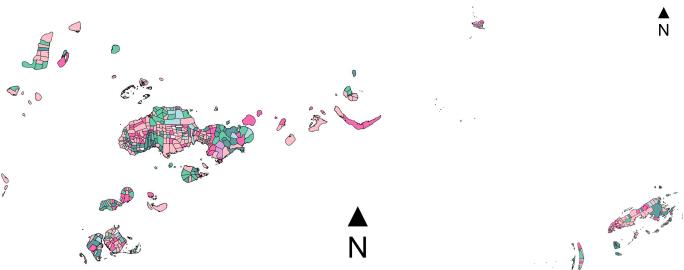
MAGUINDANAO



NORTH COTABATO



SULU



TAWI-TAWI



Dropout Rate

Low → High  
Low ↑ High





**To our Moro  
Sisters and  
Brothers**