ASSESSING THE ASSOCIATIONS AMONG GREEN SPACE TYPE, STRUCTURE, GENERAL MENTAL HEALTH AND GENERAL HEALTH USING GIS AND FRAGSTATS

Richard 'Dick' Thomas Memorial Student Competition

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Overview

- Statement of the Problem
- Significance of the Research
- Research Questions
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- Research Methodology
- Findings
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- Policy Implications and Recommendations

Statement of the Problem

- Today, many people suffer from mental health problems.
  - The lifelong prevalence of depression and anxiety in the society are 16.1% and 12.3%, respectively (Reeves, et al., 2011).
  - The World Health Organization (WHO) reports that mental health disorders are expected to be one of the major contributors to illnesses in all parts of the world by 2020 (WHO, 2008).
- Another important phenomenon that affects and decreases mental well-being is stress.
  - Stress is a health concern because, according to the diathesis-stress model, psychological disorders such as depression or anxiety are triggered and/or worsened because of the stress (Monroe & Simons, 1991).
  - Stress is estimated to affect 75-90% of people (AIS, 2013).

Statement of the Problem

- Unresolved and long-standing stress not only leads to disorders but also damages the body and causes health problems (Sapolsky, 2004).
- Centers for Disease Control and Prevention (CDC) reports that depression and anxiety as disorders cause or are associated with many health problems (Lawson & Georgiou, 2011).
- Stress, depression, and anxiety are specific conditions to assess when addressing mental well-being and there exist specific instruments to examine each in detail.
  - However, this study examined responses from more general questions that may indicate stress, depression, and/or anxiety and so adopts the term "**General Mental Health**"

Statement of the Problem

- In addition, researchers have found that mental health and general health are related to each other (Jensen, 1949; Mechanic & Hansell, 1987; WHO, 2004).
- A survey of existing research reveals that green space has positive effects on human general and mental health.
  - Green space may mitigate general mental health problems and improve general health
  - But, it has not demonstrated which types of green space are more effective than others to mitigate general mental health problems and improve general health.

Statement of the Problem

- A remaining challenge for researchers is, therefore, to identify appropriate green environments with positive effects on general mental health and general health.
- The overall purpose of this research was to explore the relationship between green space and general mental health and general health.
- Specific aims include addressing the question of whether a general specification of green space is affirmatively associated with general mental health and general health.

Significance of the Research

- This research approaches green space differently than many previous studies in that it defines different types of green space and shows associations between green space type, general mental health, and general health.
- This study also assesses structures of green space and their association with general mental health and general health.
- This study provides results that may be used as guidelines for policy makers, planners and designers regarding how to design, create, preserve or restore green spaces that people can reduce general mental health issues and improve general health.
- This study provides results indicating that two existing national datasets could be used to study the relationship between green space and mental and general health

Research Questions

1. What are the relationships between the amount of green space and general mental health and general health regardless of green space type?
2. What are the relationships between different types of green space and general mental health and general health?
3. What are the relationships between structures of green space and general mental health and general health?

Research Hypotheses

1. There is a negative statistical relationship between the amount of undifferentiated green space and increased level of poorer, BRFSS-reported general mental health and general health variables where increased green space related to less general mental health problems and better general health.
2. There are negative statistical relationships between urban green spaces, forests, rangelands, agricultural lands, and wetlands and general mental health and general health variables where increased types of green space is correlated with fewer general mental health problems and better general health.

Research Hypotheses

3. There are positive statistical relationships between landscape fragmentation and distance metrics and general mental health and general health variables, and negative relationships between size, shape and connectivity metrics and general mental health and general health variables.
4. Together, there are stronger relationships between significant green space and significant landscape structural metrics and general mental health and general health variables.

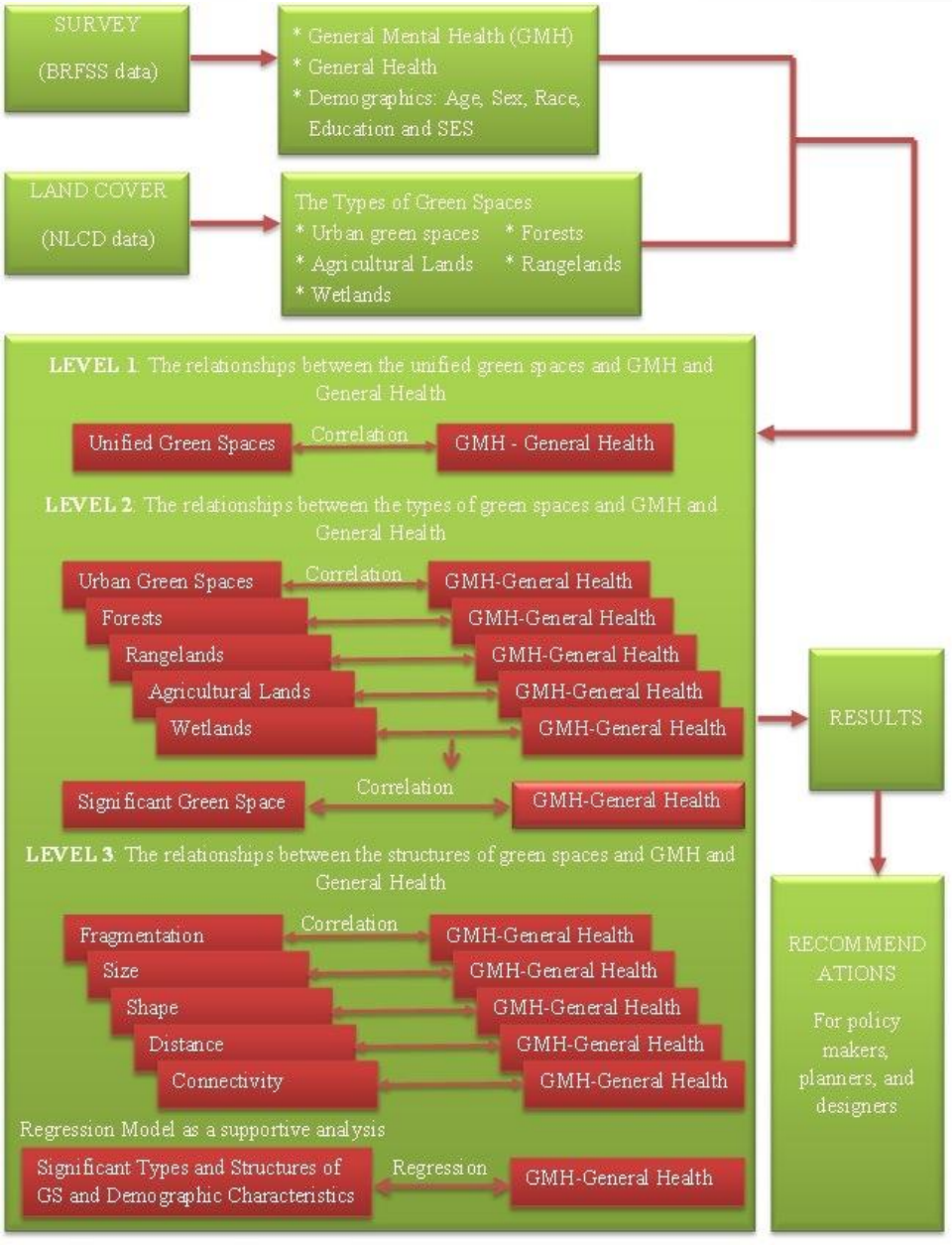
Literature Review

- Numerous studies have explored the effects of green space on health, stress, depression, anxiety and well-being.
  - Importance of Green Spaces
  - Green Spaces Effects on General Mental Health
  - Green Spaces Effects on Health and Well-being
  - Psychological Effects of Green Spaces
  - Restorative Effects of Green Spaces
  - Effects of Visiting Green Spaces
  - Effects of Amount of Green Spaces on Physical, Mental, and Social Health, Satisfaction, and Safety
  - Effects of Viewing Green Spaces
  - Effects of Access and Exposure to Green Spaces
  - Effects of Green Spaces on Children and the Elderly

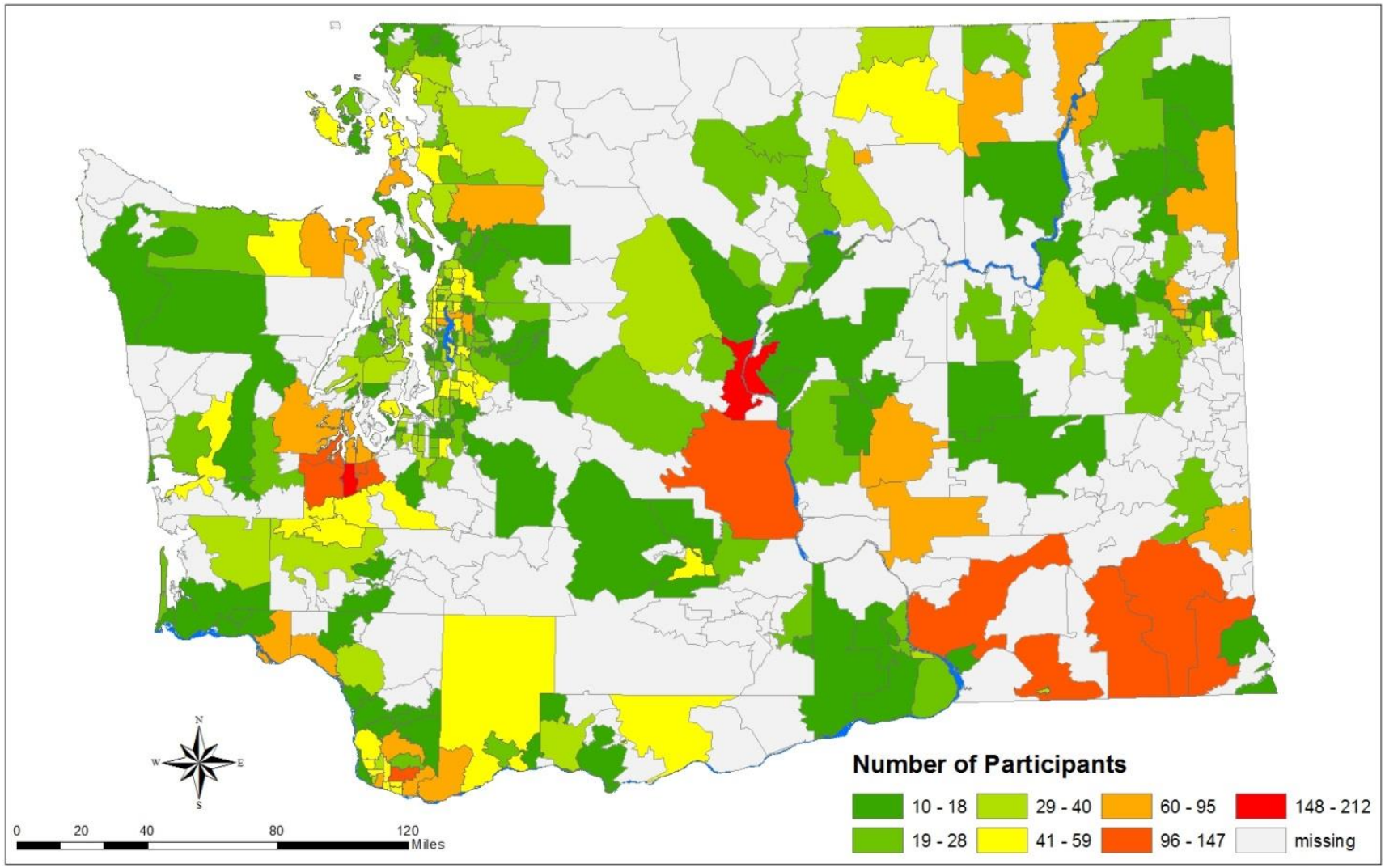
Literature Review

Authors	Types of Green Spaces				
Forman (2008)	Playing fields	Wetlands	Tree corridors	Nature reserves	Market-gardening areas
Dunnett, Swanwick, & Woolley (2002)	Amenity Green Space	Semi-natural habitats		X	Functional Green Space
Maas, et al. (2006)	Urban green	X	Forests	Nature conservation	Agricultural green
Maas, et al. (2008)	Urban green space	X	Forests	Nature conservation areas	Agricultural green space
Van den Berg, et al. (2010)	Urban green	X	Forests	Nature conservation areas	Agricultural green
Barton and Pretty (2010)	Urban Green	Waterside	Forest/woodland	Wilderness-type habitats	Countryside/ farmland
Schipperijna, et al. (2010)	Parks	Beach, sea, lake	Forests	Open nature areas	Agricultural fields

Research Methodology



Research Methodology

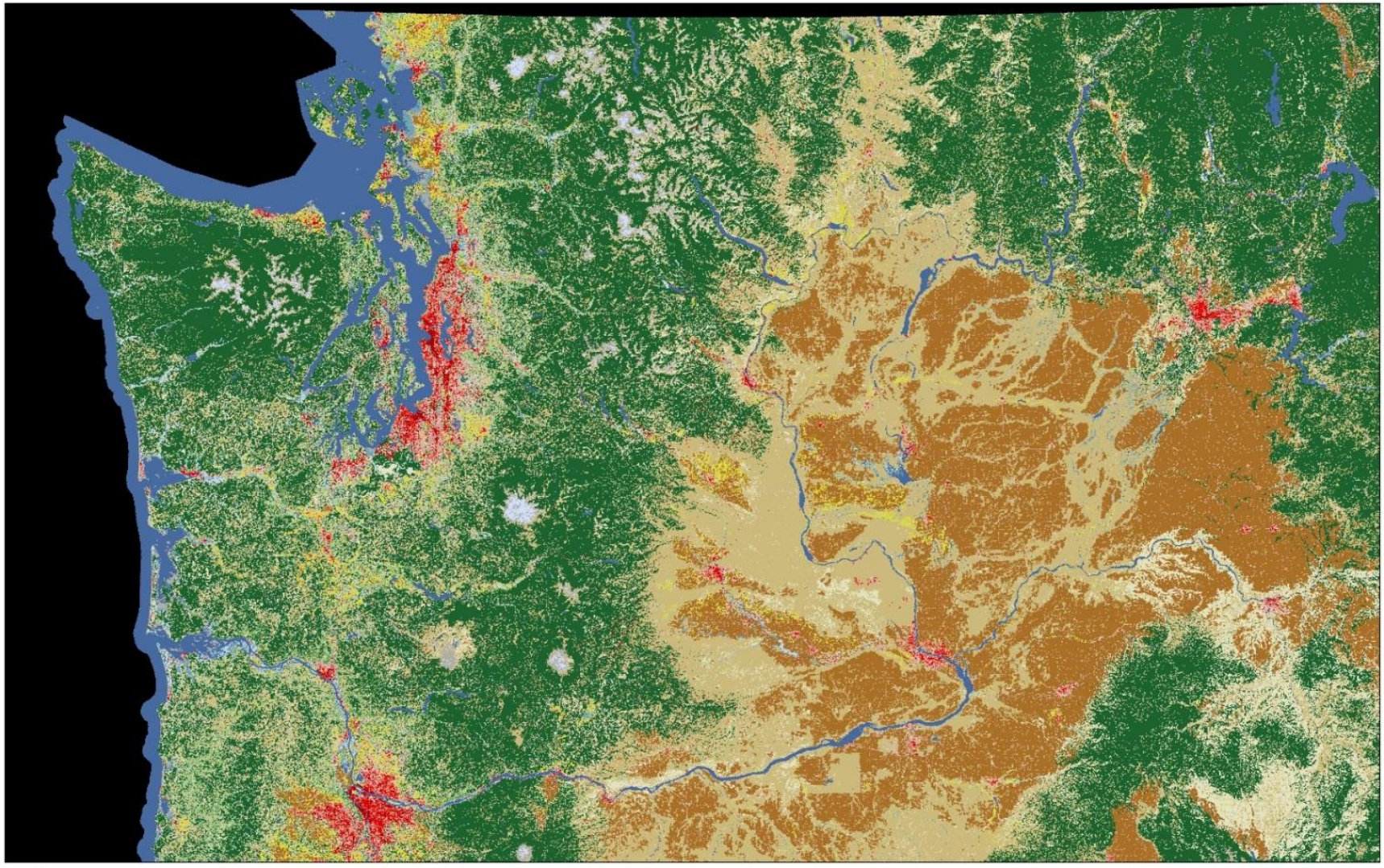


Research Methodology

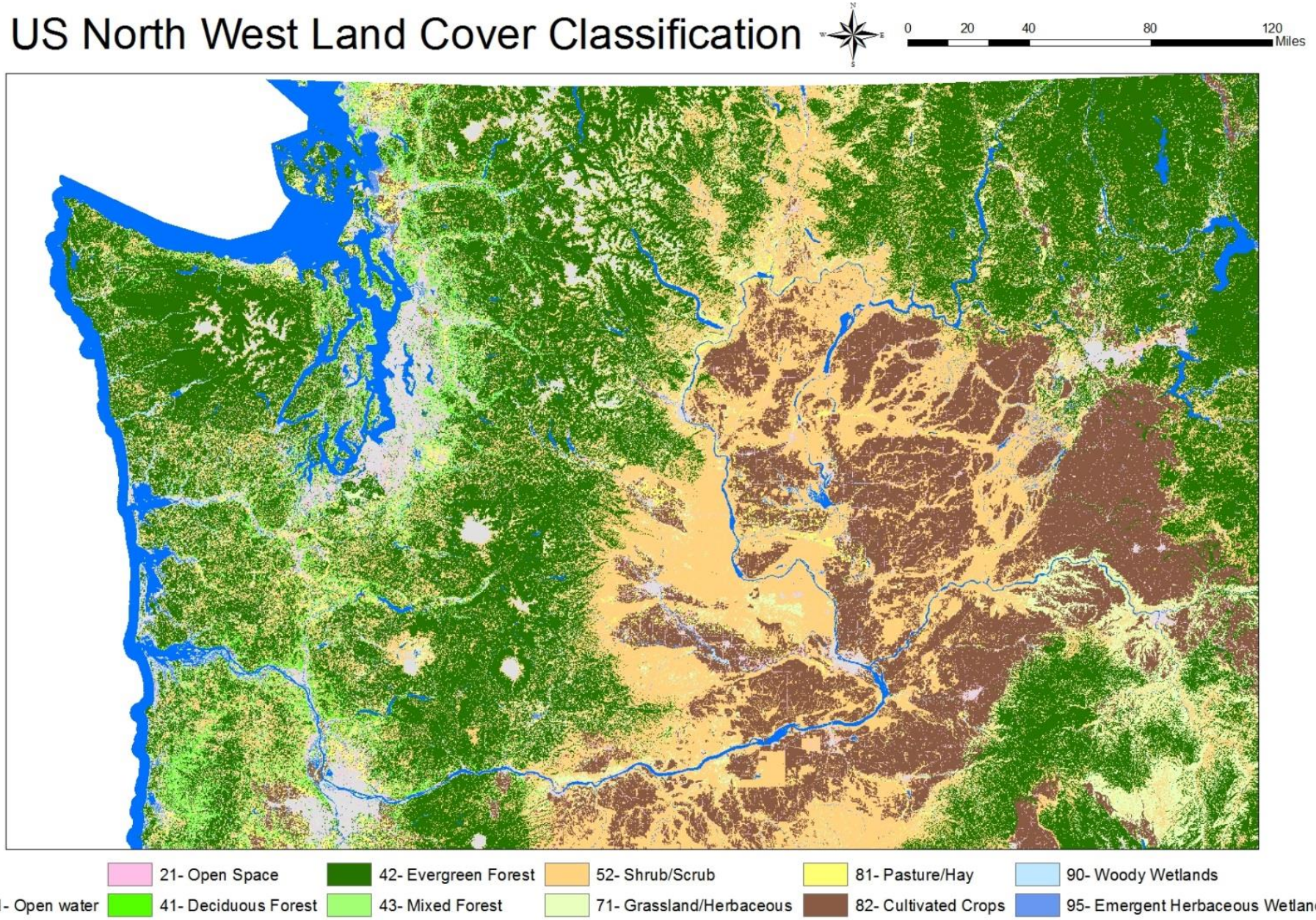
Questions	Labeled in the BRFSS	Author`s Label
(1) Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?	Mental Health	Mental Health
(1) Over the last 2 weeks, how many days have you had little interest or pleasure in doing things? (2) Over the last 2 weeks, how many days have you felt down, depressed or hopeless? (3) Over the last 2 weeks, how many days have you had trouble falling asleep or staying asleep or sleeping too much? (4) Over the last 2 weeks, how many days have you felt tired or had little energy? (5) Over the last 2 weeks, how many days have you had a poor appetite or eaten too much? (6) Over the last 2 weeks, how many days have you felt bad about yourself or that you were a failure or had let yourself or your family down? (7) Over the last 2 weeks, how many days have you had trouble concentrating on things, such as reading the newspaper or watching the TV? (8) Over the last 2 weeks, how many days have you moved or spoken so slowly that other people could have noticed? Or the opposite – being so fidgety or restless that you were moving around a lot more than usual?	Anxiety-Depression	Anxiety-Depression
Created from variable (1) in Mental Health and variables (1) to (8) in Anxiety-Depression section for participants who said "0"	Mental Health and Anxiety-Depression	No Report of General Mental Health
Created from variable (1) in Mental Health section for participants who said at least 1 day or more.	Mental Health	Report of Mental Health
Created from variables (1) to (8) in Anxiety-Depression section for participants who said at least 1 day or more.	Anxiety-Depression	Report of Anxiety-Depression
(1) Would you say that in general your health is...	Health Status	General Health

Research Methodology

US North West Land Cover Classification



Research Methodology

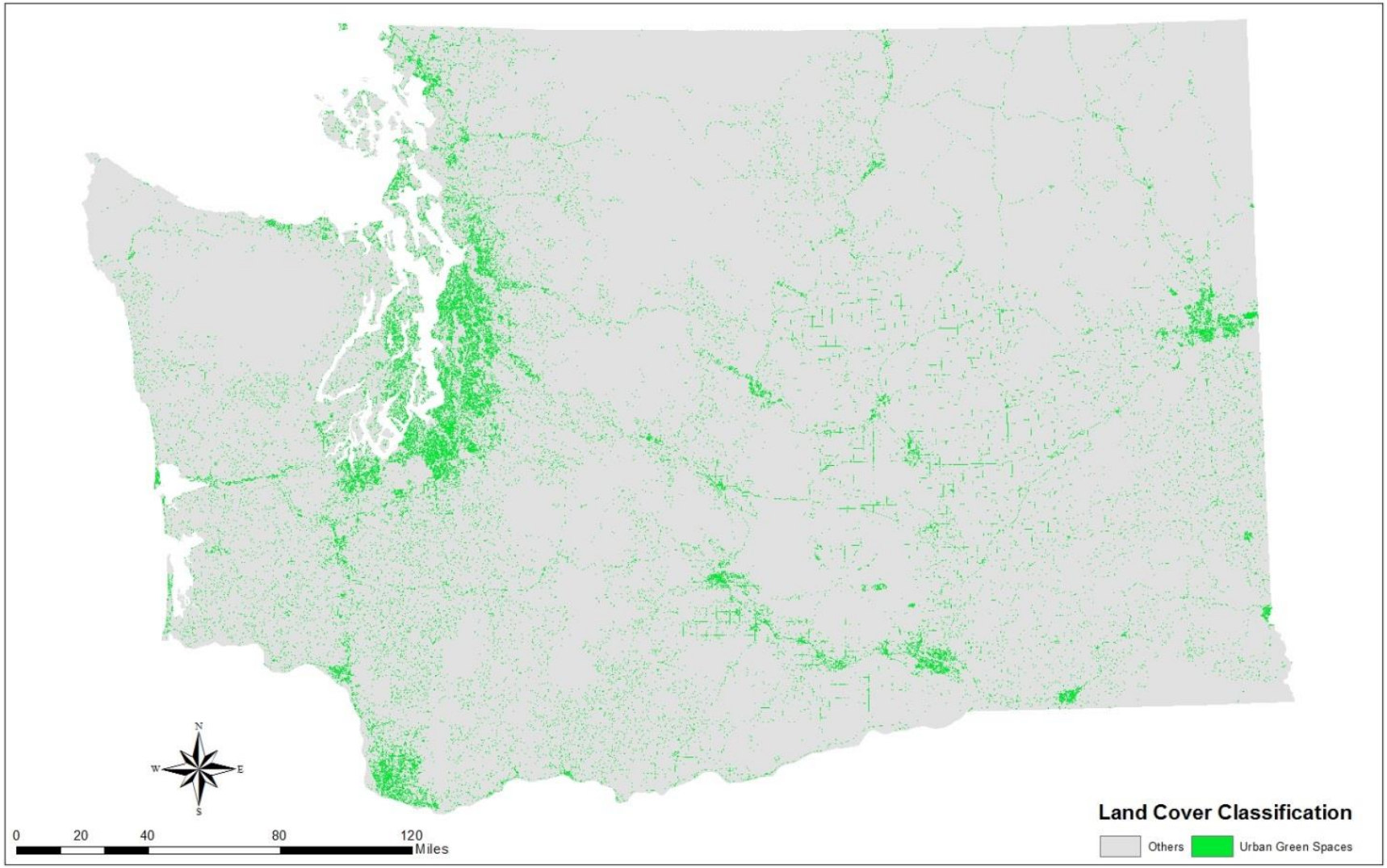


Research Methodology

The NLCD Code	Author`s Code	Author`s Label
21: Developed Open Space	21	Urban Green Spaces
22: Developed Low Intensity		
41: Deciduous Forest	41	Forests
42: Evergreen Forest		
43: Mixed Forest		
52: Shrub/Scrub	52	Rangelands
71: Grasslands/Herbaceous		
81:Pasture/Hay	81	Agricultural Lands
82:Cultivated Crops		
90:Woody Wetlands	90	Wetlands
95:Emergent Herbaceous Wetlands		

Research Methodology

Research Methodology



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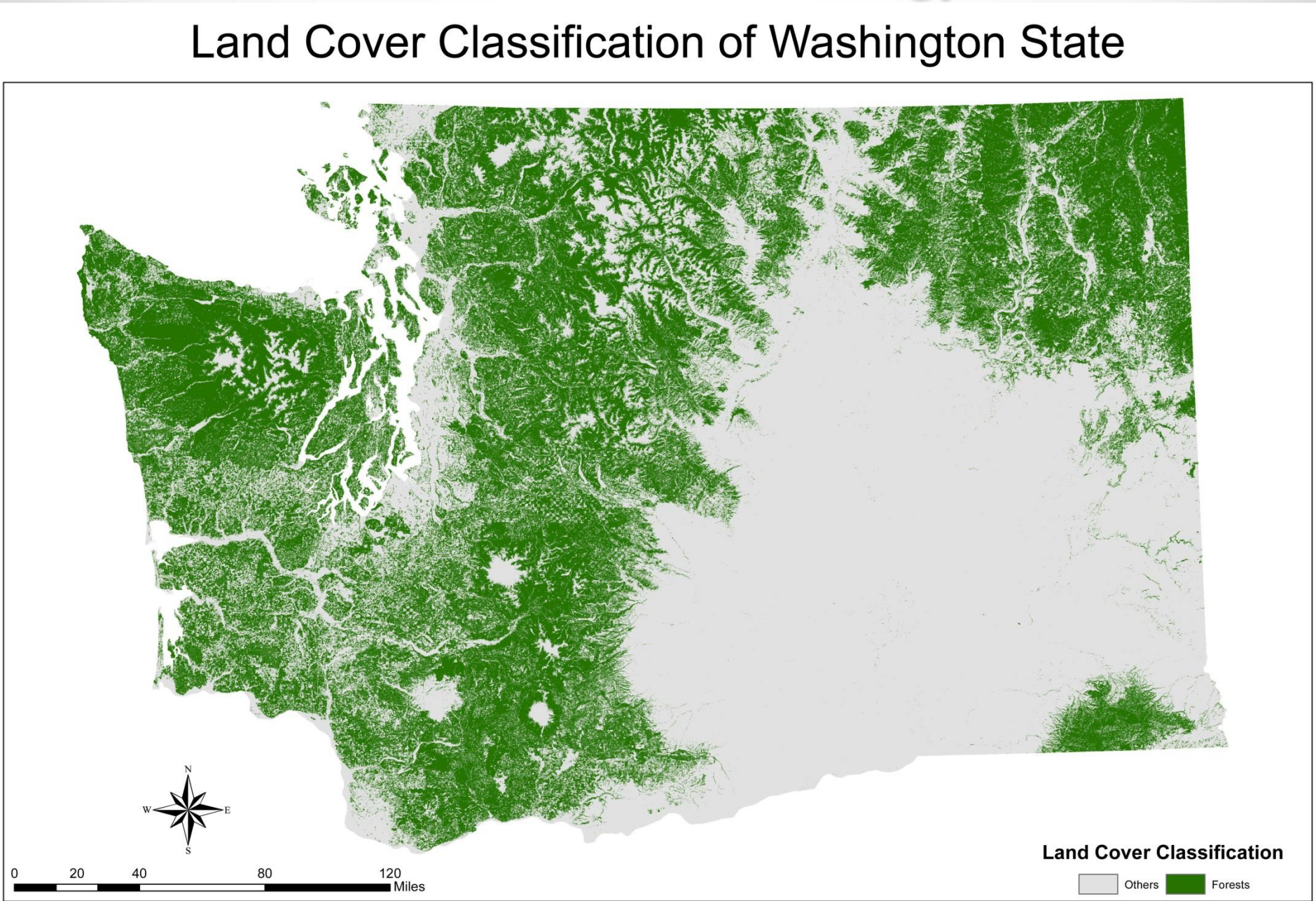

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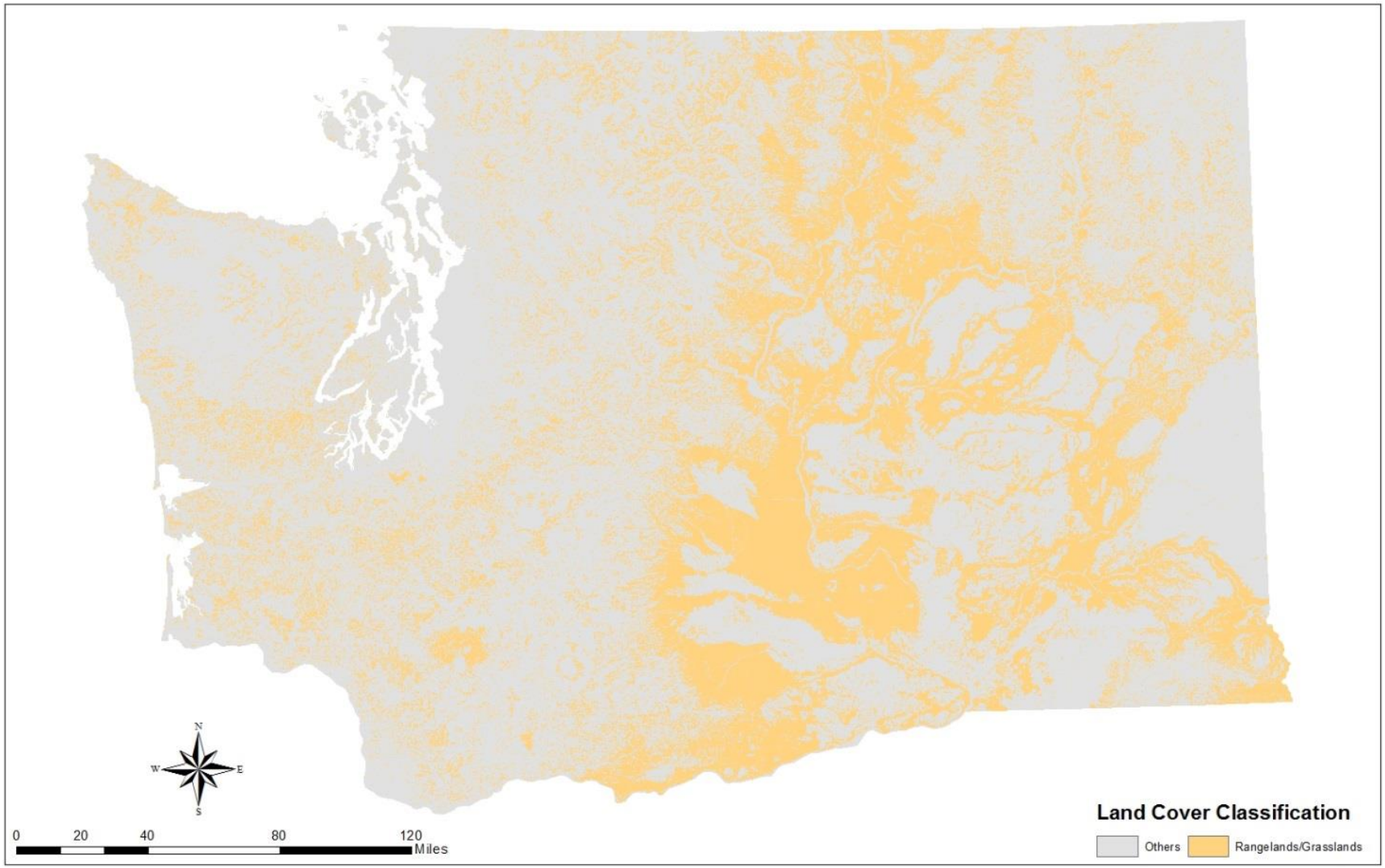

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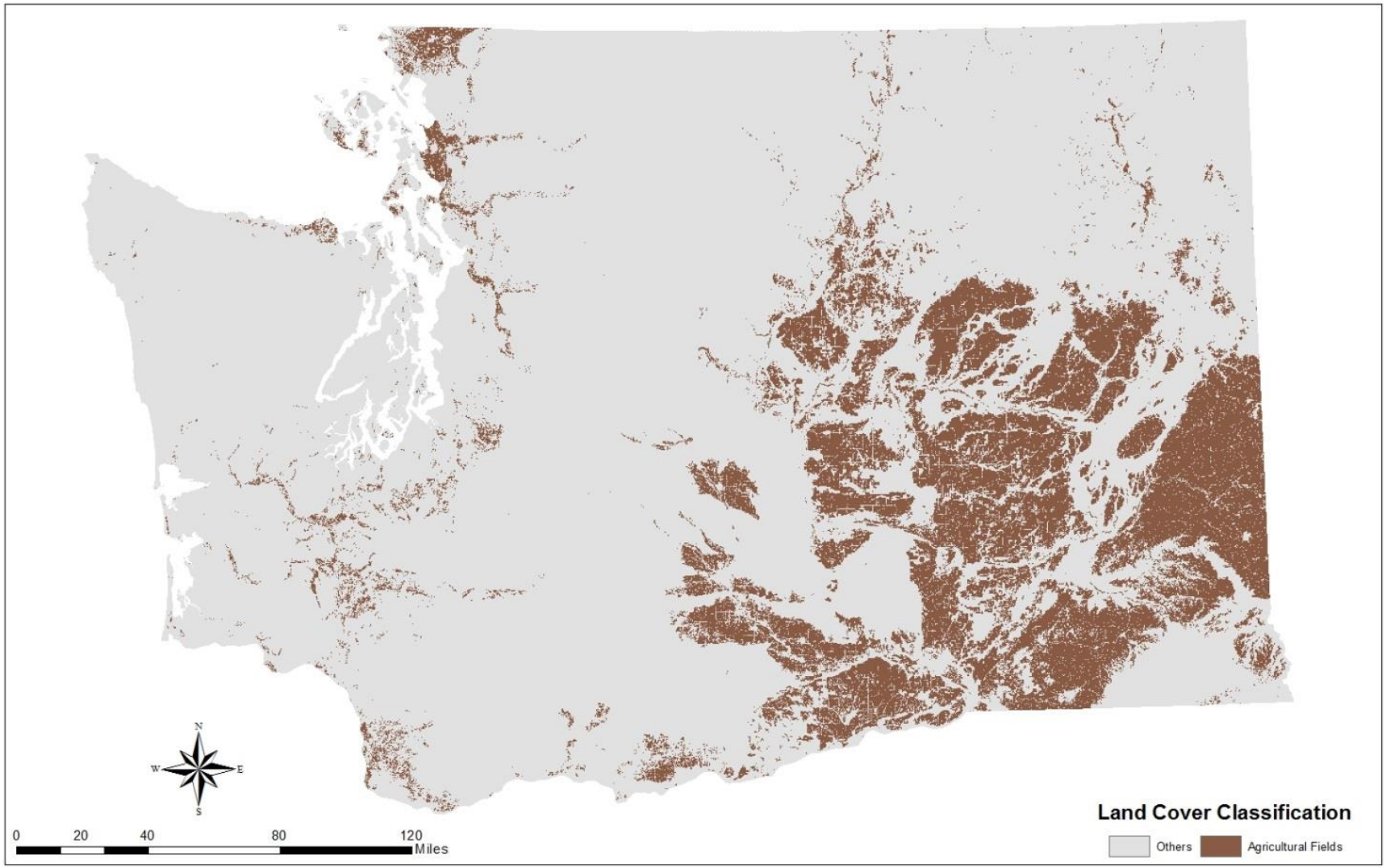

Research Methodology

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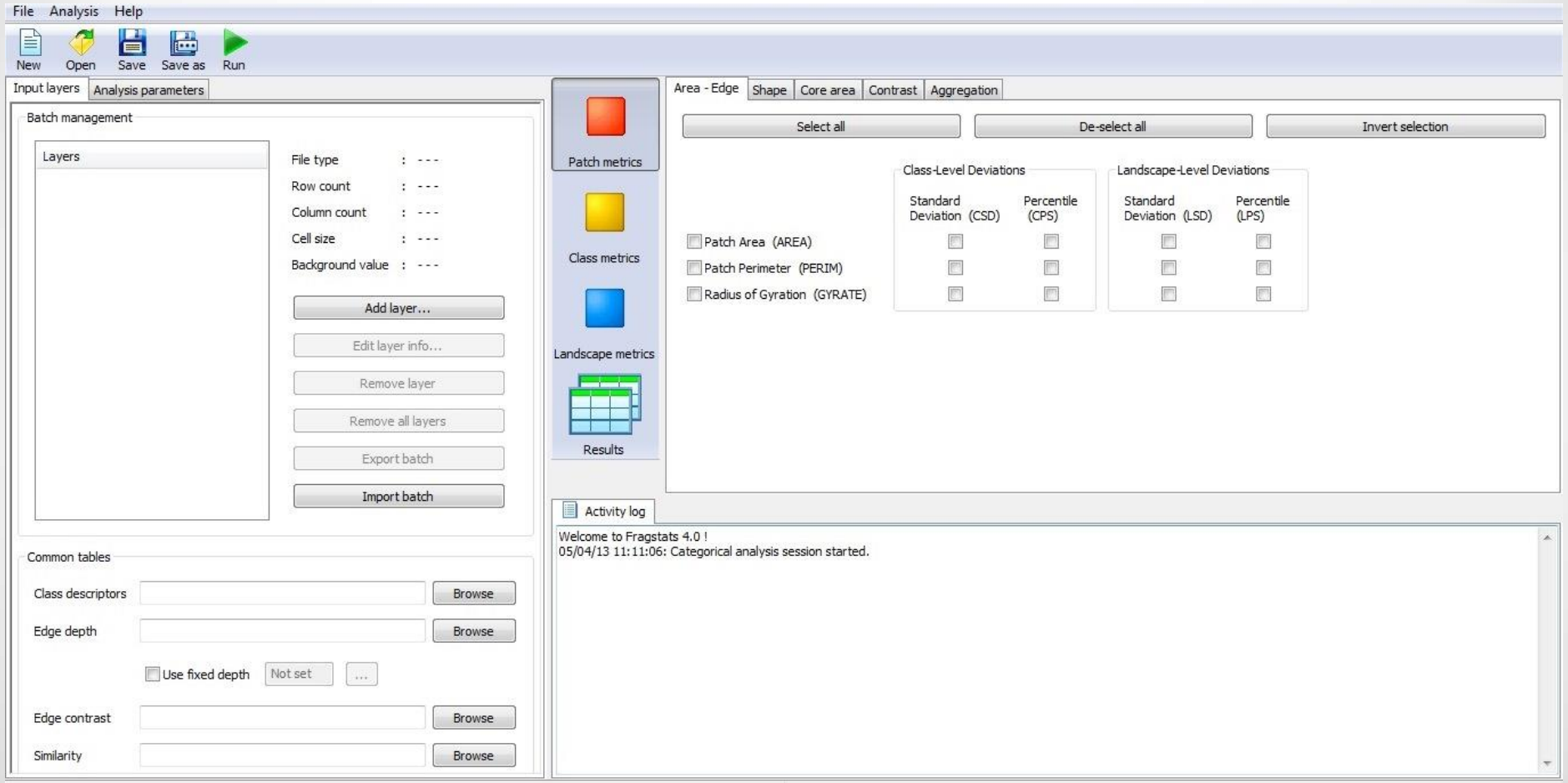

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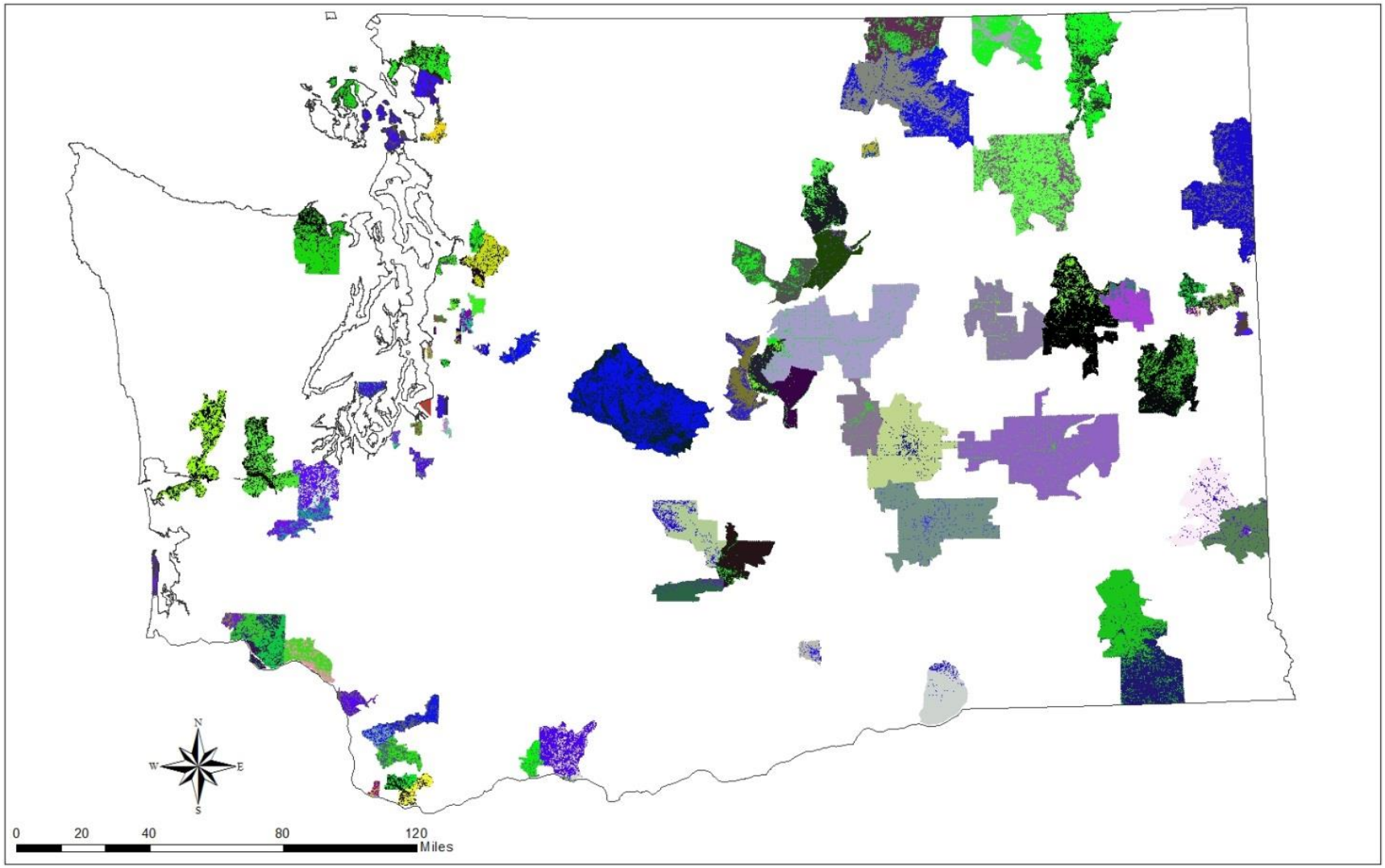

Research Methodology

Regression Model

- In the regression model, the significant results of Level 2 and Level 3 were used with demographic characteristics to determine whether independent variables predict the dependent variables.
- First, curvilinear relationships were checked and no curvilinear relationships were found between variables.
- Second, multicollinearity was checked by running collinearity statistics and no multicollinearity was found.
- Third, spatial autocorrelation was measured using spatial autocorrelation.

Research Methodology

Regression Model

- Independent variables were clustered and a less than 1% likelihood.
- Dependent variables were also clustered, with less than a 5% likelihood.
- The results did not show any statistically significant spatial autocorrelation for the residuals, which was an indicator that there is not a missing spatial variable in the model (Mitchell A. , 2005).

Findings

The Relationship between General Health and General Mental Health

Variables		Mental Health	Anxiety-Depression	No Report of Gen. Mental Health	Report of Mental Health	Report of Anxiety-Depression
General Health	Pearson r	**.364****	**. 467****	**-.290 ****	**. 359****	**.377****
	Sig. (2-tailed)	.000	.000	.000	.000	.000

**. p< .01, *. p< .05

- **Based on the Pearson correlation coefficient (Pearson *r*), the relationship between general health and general mental health is direct and moderate.**
- **When the general health level is better, general mental health problem is lower meaning there is an adverse relationship between general health and general mental health problems.**

Findings

Level 1: The Relationship between Unified Green Space and General Health and General Mental Health

Variables		Mental Health	Anxiety-Depression	No Report of Gen. Mental Health	Report of Mental Health	Report of Anxiety-Depression	General Health
Green Spaces	Pearson r	-.070	-.032	**.126***	.009	.068	.085
	Sig. (2-tailed)	.230	.581	.030	.876	.243	.145

**. p< .01, *. p< .05

- **Based on the Pearson correlation coefficient (Pearson *r*), the relationship between the percentage of unified green spaces and people who reported no days of general mental health issues was direct and weak (Pearson $r = .13$, $p < .05$).**
- **There were not any other significant results.**

Findings

Level 2: The Relationship between Different Types of Green Space and General Health and General Mental Health

Variables		Mental Health	Anxiety-Depression	No Report of General Mental Health	Report of Mental Health	Report of Anxiety-Depression	General Health
Urban Green Spaces	Pearson r	-.041	-.092	-.045	**-.125***	**-.139***	**-.268****
	Sig. (2-tailed)	.477	.111	.435	.031	.016	.000
Forests	Pearson r	**-.125***	.000	.062	-.092	-.010	-.013
	Sig. (2-tailed)	.031	.998	.290	.113	.870	.824
Rangelands	Pearson r	**.136***	.084	.053	**.207****	**.196****	**.272****
	Sig. (2-tailed)	.019	.146	.358	.000	.001	.000
Agricultural Lands	Pearson r	.004	-.030	.059	.089	.041	**.131***
	Sig. (2-tailed)	.948	.601	.308	.127	.484	.024
Wetlands	Pearson r	.015	.051	-.024	-.040	.036	.066
	Sig. (2-tailed)	.793	.379	.674	.487	.541	.253

Findings

Significant Green Space

Variables		Mental Health	Anxiety-Depression	No Report of General Mental Health	Report of Mental Health	Report of Anxiety-Depression	General Health
Significant Green Space	Pearson *r*	**-.171****	-.082	.026	**-.210****	**-.133***	**-.251****
	Sig. (2-tailed)	.003	.158	.654	.000	.021	.000

**. p< .01, *. p< .05

- **Overall, the results revealed negative significant relationships between significant green space and the general mental health and general health variables.**
- **The strength of relationships was stronger than urban green space or forest alone.**

Findings

Level 3: The Relationship between Structures of Significant Green Space and General Health and General Mental Health

Variables		Mental Health	Anxiety-Depression	No Report of GMH	Report of Mental Health	Report of Anxiety-Depression	General Health
Largest Patch Index (Fragmentation)	Pearson r	**-.124***	-.077	.016	**-.178****	**-.210****	**-.141***
	Sig. (2-tailed)	.032	.183	.781	.002	.000	.015
Patch Density (Fragmentation)	Pearson r	.021	.010	**-.117***	-.036	-.021	-.048
	Sig. (2-tailed)	.724	.866	.043	.538	.717	.405
Standard Deviation of Patch Area (Size)	Pearson r	-.011	.094	.001	-.018	.049	.061
	Sig. (2-tailed)	.856	.104	.987	.752	.401	.296
Shape Mean (Shape)	Pearson r	.084	-.011	-.002	.091	-.029	.048
	Sig. (2-tailed)	.149	.853	.979	.118	.617	.413
Shape standard deviation (Shape)	Pearson r	-.005	-.050	.077	.052	.112	.031
	Sig. (2-tailed)	.926	.388	.182	.372	.053	.599
Euclidian Nearest Neighbor distance Mean (Distance)	Pearson r	**.179****	**.130***	.020	**.230****	**.184****	**.222****
	Sig. (2-tailed)	.002	.025	.725	.000	.001	.000
Euclidian Nearest Neighbor distance Standard Deviation (Distance)	Pearson r	.096	.073	.059	**.154****	**.150****	**.150****
	Sig. (2-tailed)	.097	.207	.313	.008	.010	.010
Cohesion Index (Connectivity)	Pearson r	-.091	**-.128***	.095	-.100	-.030	-.105
	Sig. (2-tailed)	.116	.027	.103	.085	.602	.071

Findings

Regression Model of Significant Types and Structures of Green Space

Variables	Mental Health	Anxiety-Depression	No Report of GMH	Report of Mental Health	Report of Anxiety-Depression	General Health
Age	**-.053 (.019)** *	**-.015 (.006)** *	**.327 (.072)** **	.001 (.051)	.006 (.015)	**.011 (.003)** *
Sex (Male)	-.003 (.009)	**-.007 (.003)** *	**.066 (.033)** *	.016 (.024)	-.003 (.007)	-.002 (.001)
SES	**-.071 (.020)** **	**-.031 (.006)** **	**.212 (.075)** *	**-.126 (.054)** *	**-.077 (.016)** **	**-.023 (.003)** **
Education Level	.000 (.009)	-.001 (.002)	.023 (.032)	-.018 (.023)	.005 (.007)	**-.003 (.001)** *
Significant Green Space	-.002 (.005)	.003 (.002)	-.020 (.020)	-.020(.014)	.004 (.004)	**.002 (.019)** *
Fragmentation	.041 (.013)	.023 (.034)	-.651 (.444)	-.275 (.319)	.008 (.093)	.001 (.001)
Distance	**.009 (.004)***	**.003 (.001)** *	-.012 (.016)	.021 (.011)	**.010 (.003)** *	.001 (.001)
Connectivity	.003 (.034)	-.009 (.011)	.060 (.136)	-.052 (.098)	-.010 (.028)	.011 (.006)

**. p< .01, *. p< .05

Limitations of the Study

1. One of the limitations was that this study used secondary data which did not provide respondents' exact locations within the zip-codes.
2. The other limitation was that the NLCD was available only for 2006 while BRFSS was available for 2010.
3. A final limitation was that the NLCD data is comprised of 30 m cells, meaning that that finer resolution details are not represented

Policy Implications

For Policy Makers, Designers, and Planners

- Green spaces should not be seen as either "luxury" or as "simply green" in the planning, design, and decision making process. Green spaces should be allocated a more central position in planning, design, and decision making policy.
- Healthy planning should include a place for green spaces. Policy makers, designers, and planners should take the amount of appropriate green spaces in the living environment into account when endeavoring to improve health.
- Policy makers, designers, and planners should fully accommodate the positive responses of urban and rural residents to structures of green spaces into planning and management practices.

Policy Implications

For Policy Makers, Designers, and Planners

- When designing and planning new residential developments, renovating existing urban infrastructure or consulting on land use priorities, the amount of urban green spaces and forests should be as much as possible; and the distance between them should be as close as possible. In addition, in cities and existing settlements the amount of green spaces should be increased, and access to forests should be improved.
- New settlements or residential developments should be away as much as possible from rangelands and agricultural lands.
- Green spaces should be less fragmented, less isolated, and more well-connected.

Recommendations

For Future Studies

- Future research should definitely consider the different types of green space in the studies. In order to have better and accurate results, different types of green spaces should not be regarded as “simply green”.
- Future studies should consider and use rangelands and wetlands as types of green space.
- Structures of green space should be studied in the future research.
- In future studies, researchers need to move beyond secondary data analysis and collect primary data and when collecting primary data responses` view, visits, and exposure to the types of green space should also be considered to measure the relationships between types of green space and human mental and general health.

Recommendations

For Future Studies

- In future studies, it should be studied to determine how big a green space should be in terms of better effects on human mental and general health.
- Further research is needed to give more insight into the mechanisms behind the relation between green space and health by not only looking at the types of green space but also looking at the characteristics of types of green space. By doing this, it will be more clear which components or characteristics of specific types of green space constitute the most important drivers of human health.
- Global land cover database should be developed so that researchers can look at the relationship between health and green space across the globe.
- For future research, interdisciplinary collaboration between the social, health, and natural sciences is recommended.

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THANK YOU

QUESTIONS & COMMENTS