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Urbanization in Central Asia; a GIS Analysis of Ulaanbaatar, Mongolia

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A GIS analysis of Ulaanbaatar, Mongolia

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Signature Page

A Comparative Analysis of Urbanization in Mongolia and
Post-Soviet Central Asia

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Abstract

Urbanization presents problems for developing countries around the world. Cities undergoing urbanization are typically receiving an influx of immigrants from rural areas and a high natural increase rate. They experience problems such as poor sanitation, lack of waste management services, lack of improved water, lack of electricity, informal housing and economic activities, and congestion. However, urbanization in post socialist Central Asia is unique. While these problems are present in these cities, including Almaty, Astana, Bishkek, and Ulaanbaatar, their histories and political systems have created unique urban environments with their own sets of problems. Soviet influence combined with their nomadic cultural heritage has urban spaces with a unique set of challenges. Mongolia, in particular, has created urban environments unlike any other cities in the world, and has a very unique set of problems. This research aims to determine the viability and social and economic sustainability of these cities, as well as residential satisfaction in these cities. In addition, it offers suggestions as to how Ulaanbaatar's supporters and government officials can work to improve Ulaanbaatar's infrastructure, and discusses potential solutions to combat the public health crisis concerning Ulaanbaatar's air pollution.

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Introduction

Much has been written about the urbanization that occurred in the so called "first-world" in the 19th and early 20th century, as well as the urbanization currently occurring in the so called "third-world." However, an area that has received less attention is urbanization in the post-socialist "second-world." Further, much of the literature on this topic has been focused on China. The urbanization processes of a regions characterized by an entirely different political and economic system.

This research will focus on urbanization in post-socialist Central Asia, in states such as Mongolia, Kazakhstan, Tajikistan, and Kyrgyzstan. Central Asian cities are unique not only due to their soviet influence, but because the area has largely been rural and nomadic for most of its history. These cities exhibit features that reflect both their historical Soviet influence and their nomadic heritage. Mongolia is particularly interesting because, unlike the post-Soviet states, which were forced to abandon their nomadic practices, Mongolia has incorporated some of its traditional nomadic practices into its urban spaces.

The problems associated with these places are a result of historical Soviet influence, their nomadic backgrounds, and their unique environmental features. Soviet influence has created problems such as urban-rural conflict within states, migration restrictions, and housing shortages, as well as the current poor economic situation of the majority of these states. These states' nomadic heritage has also created urban-rural conflict, as well as sprawling patterns of development that it is difficult to extend infrastructure and public services to the majority of the city's residents. These countries' environments also cause unique problems, as they possess large amounts of land, resulting in sprawling open spaces that can result in differences and conflict

between different parts of the country. Central Asia is also incredibly dry, and in most places, exceptionally cold, it is also littered with mountain ranges and deserts (see Figure 1). This not only places limitations onto where urban development can occur, but burdens areas of cities that lack heating and electricity.

While there are many problems in these Central Asian cities, including the typical problems associated with urbanization as well as the issues unique to the region, there are some advantages to the unique situation as well. This research aims to make a balanced analysis of the challenges and advantages faced by these cities. It also aims to answer questions about the economic and social sustainability of the current patterns of development in these cities. Are these practices sustainable? Are the residents of the cities satisfied with their living situation? Are the approaches in place for solving the problems in these cities going to be enough to make these cities economically and socially sustainable? What are the advantages to living in these cities? These are the large questions that will be addressed in this research. With background information from related literature and results from the research, the economic situation and living conditions in these cities will become clearer.

Review of Related Literature

Introduction

Central Asia is home to a number of nomadic groups. Mongolia, Kazakhstan, Tajikistan, and Kyrgyzstan are all deeply influenced by their nomadic heritage. These regions have historically been defined by nomadic animal husbandry on the steppes. The horse has been incredibly important in these societies, and their economies have been subsistence level pastoral

nomadism based off of raising sheep, goats, cattle, camels, and yaks. They have lived in round tents covered in skins, felt, or leather called yurts (Turkic) or *gers* (Mongolian) (see figures 2 and 3) that allow for the mobility required for their nomadic lifestyle. They have traditionally been relatively egalitarian and have placed considerable value on open space. These societies have thrived in Central Asia for thousands of years because pastoral nomadism is a practical way of surviving on the barren steppes and deserts, which receive too little rain for crops. These traditions have been maintained for thousands of years, however, they were interrupted by socialism and Soviet influence. The USSR forcibly ended nomadic practices in its socialist republics, including Kazakhstan, Tajikistan, and Kyrgyzstan, which were forced to give up nomadic practices. Mongolia, while under Soviet Influence, was not a part of the USSR, and managed to maintain its nomadic practices until the past two decades. Mongolia, did, however, have strong ties and obligations to Russia since 1911, when Russia aided Mongolia in its independence from China.

Urban-Rural Migration and Urbanization

In total, cities in the developing world are gaining about 45 million new inhabitants each year, or 125,000 a day. Throughout history, industrialization and urbanization have occurred simultaneously, and industrialization has been a direct cause of urbanization. As demand for labor increases in towns, and advances in technology in agriculture allow for emigration out of urban areas, migration occurs out of rural areas and into urban areas. This migration has historically followed a distinct pattern, with urbanization occurring gradually at first, and eventually accelerated, when the majority of a country's population has urbanized, it begins to slow down again. However, the rate of urbanization in modern developing countries do not follow this pattern, and they are urbanizing much more rapidly than industrializing countries did

in the 19th and early 20th centuries. One explanation for this is that, due to improved medical care, death rates have decreased, while birth rates remain high (Potter and Lloyd-Evans, 1998).

Urban-rural migration also occurs due to a number of "push" and "pull" factors. Pull factors include improved health care available in cities, employment, higher wages, educational opportunities and the potential for an improved physical environment. Push factors include the unemployment and poor living conditions in rural areas, which are often worse than the conditions in informal urban settlements (Potter and Lloyd-Evans, 1998). While these are these factors explain rural-to-urban migration in general, urbanization post-Soviet states and Mongolia has been unique, and has occurred due to unique political and environmental causes that have some differences compared to traditional rural-urban migration.

Socialism in the USSR

The USSR aimed for the most extreme and authoritarian form of socialism, Communism. Communist ideology aims to transform private ownership to fully social ownership. It is characterized by two features, classlessness, which means that a society has eliminated social classes and the inequalities that accompany them, and collectivity, or placing the rights of ownership to all who work to produce the goods and services created for society. In the communist ideology, socialism is viewed as a transitionary state between communism and capitalism. Stalin aimed for agriculture to be practiced in collective farms, and the USSR banned private, subsistence level agriculture. In fact, every area of life could be determined by the autocratic Soviet government. The most important factors in determining the urbanization patterns in the post-Soviet states were the banning of subsistence level, private agriculture, and the limitations placed on migration and residency (Resnick and Wolff, 2013).

Within the USSR, Soviet Socialist Republics were under the *propiska* system of residency permits, which were written in residents' passports. These permits were aimed to manage internal migration and restrict free movement. The socialist ideology also established a separation between the countryside and the city. The Soviet Union also maintained strict border controls, preventing its citizens from travel. It also attempted to separate residents from the regions where they traditionally had shared cultural beliefs and practices (Schröder, 2016).

Effects of Socialism in the post-Soviet States

The *propiska* system is still in place in most former Soviet Socialist Republics, however, it is not as strictly enforced by local authorities as it was during the Soviet era. This means that many of the cities in the former Soviet Republics are have been seeing large influxes of residents abandoning neglected rural areas to find move to urban areas. Each state has seen a specific stimulus for an increase in migration to cities; Tajikistan saw a large influx of immigrants to Dushanbe during its civil war (1992-1997), Kyrgyzstan witnessed large influx of immigrants to Bishkek during the Tulip Revolution, and Astana in Kazakhstan received a large number of immigrants after it was established as Kazakhstan's capital in 1998 (Schröder, 2016).

The *propiska* system has left a deep divide between the urban and rural residents of the former Soviet republics. Violence in Bishkek is associated with rural immigrants, as are new and "unaesthetic" construction projects in Astana. The new settlements that immigrants will typically first move into are also usually informal; they are considered illegal and residents do not have access to social services, health care and education because they lack a residence permit. (Schröder, 2016). The divide between "urban" and "rural" in the former Soviet Republics seems to be more important than ethnic divides. An ethnic Russian that has grown up in Bishkek is can be accepted as an urban *Bishkekchanin*, but a Kyrgyz rural migrant never will be. They will

always, to some degree, be considered a *myrk*, a "newcomer." *Myrki* (plural) are associated with poor grammar, aggression and rude behavior, bad appearance, and bad smell. The divide between "urbans" and "newcomers" has fostered a bond between urban ethnic Russians and Kyrgyz. They view *myrki* as a common enemy, because they believe that the rural "newcomers" are threatening their economic prospects in the city (Schröder, 2016).

The *Ger* and Socialism

Mongolia, while technically an independent state since 1921, was pulled into the geopolitical and cultural sphere of the Soviet Union. Cultural influence was obvious, the traditional Mongolian script was replaced by Cyrillic, hundreds of monasteries and temples were destroyed, the Mongolian flag was changed to reflect communist ideology, and statues of Genghis Khan were removed from the city. Mongolians were encouraged to move into apartments and abandon their *gers*. Soviet Influence is still noticeable in the architecture and urban design of Ulaanbaatar today (Diener and Hagen, 2013). However, Mongolia was never forced to give up its nomadic heritage, it has only recently, in the last two or three decades, begun to urbanize due to harsh climactic conditions and industrialization in Ulaanbaatar. The *ger* is still the typical housing mode in Mongolia, and they are not viewed negatively. In fact, based on a 2016 survey, peripheral *ger* areas in Ulaanbaatar are generally viewed more positively than central *ger* areas, which are closer to the services of the central city. Environmental conditions are better in peripheral areas; there is more open space and less smoke. Central *ger* areas are associated with crime, garbage, and alcoholism. The newest migrants to the city had lived there for an average duration of 12.4 years, the middle district residents had lived in the city for 18.0 years, and residents of the outer districts had lived there for 23.1 years (Anderson, Hooper and Tuvshinbat, 2017). Mongolians, unlike the residents of the former Soviet Socialist Republics,

still have positive perceptions of rural life, and it is the new immigrants to the city that adopt a more "urban" lifestyle. The fact that the longest-term residents of the *ger* districts are the ones that have still maintained some nomadic cultural practices, such as living in a *ger* rather than building a house, demonstrates that Mongolians still have an attachment to their nomadic lifestyles, unlike their former Soviet republic neighbors.

According to a 2010 survey of residents of Ulaanbaatar's *ger* districts, 68% are satisfied with their homes, 69% like their neighborhood and 57% believe that their dwelling is suitable for their family. 44.3% are not interested in moving. Unlike most squatter settlements, 79% of residents of the *ger* districts own their land, and only 9% are living there illegally (Caldieron and Miller, 2017). This is because every citizen in Mongolia is entitled to their own plot of land, which is given to them by the government. This is in stark contrast to the former Soviet Republics, where newcomers struggle to find legal housing due to the *propiska* system of residency permits.

The Ulaanbaatar master plan demonstrates a desire to honor nomadic heritage, it directly states that it will respect "the nomadic heritage which has endured many centuries." It does this by focusing on decentralization and takes a stance against excessive densification, as well as by placing an emphasis on open space and focusing much of the document on methods to improve the *ger* districts. It focuses on creating satellite towns around Ulaanbaatar, each with their own specialized agricultural, industrial, manufacturing, or logistics focus. It also puts emphasis on open space, promising to set aside areas not only for open space, but a large green belt designed to limit outward city growth, forested areas, and summer camp zones. The document also discusses plans to transform the *ger* districts into areas with self-sustaining utilities and single-

family homes, rather than focus on just encouraging residents to move into apartments (City of Ulaanbaatar, 2014).

Housing Problems in Post-Socialist Cities

However, despite the positive cultural associations and attributes the *ger* districts might have, they are still a form of informal housing and pose a range of problems. Solid waste management, hygiene, and sanitation are all high-priority issues in all *ger* areas. No formal roads exist in the middle and fringe *ger* areas. Residents of the *ger* districts are younger, less educated, poorer, more reliant on social services, and live in larger family units than residents of the apartment areas. Residents rely on wood and coal burning stoves for heating, cooking, and water sanitation, resulting in severe air pollution, especially during the winter. Unemployment rates are higher 49%) than in apartment areas. Garbage and human waste are often simply left outside, because the *ger* districts lack waste disposal services (Choi, 2012).

The *ger* districts and the problems created by them do not only exist in Ulaanbaatar. The second largest city in Mongolia, Darkhan, faces shortages of safe, clean water. Although most of the water can be considered improved, people must still use water from additional, unsafe water sources, and that they cannot afford enough water to meet their basic needs. While 99% of households (according to a 2011 survey) use state-operated water kiosks as their main source of water, 43% of respondents use water from private wells as a secondary source. Additionally, water consumption in Darkhan is relatively low, 5 to 10 liters per day, rather than the standard 12 liters. While this may be due in part to the fact that most Mongolians use public bathhouses i8rather than private showers and baths, 71% of respondents consider the water from kiosks to be "expensive and not affordable," which may contribute to low water usage (Sigel, Altantuul and Basandorj, 2014).

The former Soviet Socialist Republics also have problems accommodating the rural immigrants into their cities. For example, in Almaty, Kazakhstan, it is often a struggle for new immigrants to find housing, and this is exacerbated due to the *propiska* system. In order to find housing for themselves, residents of Almaty may resort to dividing a single-family home between two families, working as a caretaker of older residents that own a home, living in the homes of distant family members, inheriting a home from their parents many generations of a family might live in the same home in Almaty), and renovating an old, abandoned house (Brown, 2014).

Current Solutions

One of the contributing factors to the lack of affordable housing in Almaty is that it had simply reached its limits, with rugged mountains to the south and deserts to the north, Almaty had run out of room to grow. Not only was future growth limited, but it was a poor choice for a capital city because it is located near the southern border of Kazakhstan made it difficult to get to, and vulnerable to a Chinese invasion. It also is located in a seismically active area. Kazakhstan's solution to these problems was to move their capital from Almaty to Astana. This move also sought to create a national identity by being centrally located between the ethnic Russians in the north and the ethnic Kazakhs in the south (Köppen, 2017). In a 2013 survey that interview Kazakhstani residents nationwide, the top three reason they gave for the capital city's move to Astana was that it was in a seismically active area, that the capital needed to be in a more centrally located area, and that it was a symbol of their independence from the USSR (Almaty was designated as the capital of Kazakhstan by the USSR, and is seen by some as a symbol of oppression). Interviewees also pointed out that Almaty lacked space, and the problem was exacerbated by the fact that skyscrapers could not be built due to earthquakes (Koch, 2017).

One of the primary reasons for Kazakhstan's capital's move from Almaty to Astana seems to have been a way to remove barriers to urban development.

Mongolia has taken different approaches to fixing the problems in its cities. Ulaanbaatar has taken an incremental approach. Ulaanbaatar has accepted help from private not for profit organizations so create strategies to turn the city's *ger* districts into a viable urban construct, such as the Rural Urban Framework, which has designed systems for *ger* household to access services such as water and electricity, and has worked to train construction workers (Bolchover, 2017).

Of course, Ulaanbaatar's master plan outlines other strategies are meant to help the improve the *ger* districts, as previously discussed. However, there are barriers to the implementation of this plan. The first problem is that the transition to a post-socialist society has resulted in an institutionally weak, but highly politicized government. The second problem is that Ulaanbaatar's urban planning and land administration organization operate separately, and there is very little cooperation between these two organizations. The third problem is that the Mongolian government does not have the power to forcibly acquire land; in all *ger* districts, land and property rights are protected by law, and development firms are not able to acquire land for construction purposes. A fourth problem is that the current land market is still caught up in its heavily regulated communist past. Land prices are legally set at 13,200 tugrik per one square meter of land. However, prices are usually higher as they are traded openly and illegally through the free market. A fifth problem is that the Mongolian government is required to provide land for every Mongolian resident, however, due to rapid urbanization the government is forced to allocate land along the fringes of Ulaanbaatar, which are devoid of infrastructure, and it is difficult and expensive to provide infrastructure to these areas (Byambadorj, Amati and Ruming, 2011).

Contrasting Mongolia with the Post-Soviet States

Today, the former Soviet Socialist Republics and Soviet influenced Mongolia all show similarities due to their shared histories as nomadic societies, and they all share cultural, architectural, and urban form features that they inherited from the USSR. However, Mongolia is distinctly different from the USSR in several ways. First, Mongolians have maintained their *gers* as a housing type (Byambadorj, Amati and Ruming, 2017), while the former Soviet republics were forced to give up their yurts under Soviet rule. Second, the *ger* districts are viewed as a viable form of housing by the middle class, and is home to well-educated residents such as professors, doctors, and government officials (Byambadorj, Amati and Ruming, 2017). The peripheries of the cities in the former Soviet republics are viewed as somewhat rural, and where the poor "newcomers" live. Third, the *ger* districts are no longer viewed as informal settlements. The homeowners there own their land legally, and the government has recognized them as official districts (Byambadorj, Amati and Ruming, 2017). The former Soviet republics peripheral settlements are viewed as traditional, informal squatter settlements.

The modern day *ger* districts are distinct from both the city and the countryside, where pastoral nomadism is not retained, but many of the associated traditions still are. Many residents of the *ger* districts have found ways to use the unique qualities of the *ger* districts to their advantage. The *ger* districts offer opportunities for education and economic participation for most of Mongolia's residents. This means that the success of the *ger* districts is vital not only to the residents of the *ger* districts, but to Mongolia as a whole (Miller, 2017).

The former Soviet Republics are different from Mongolia today, especially in terms of how they view their settlements on the periphery of the city. Historically, attitudes towards "newcomers" living on the periphery of the city has been viewed as an ethnic issue in Bishkek.

The “urbanites” were the Russians, and the “rural” or “newcomers” were the Kyrgyz. In 1959, ethnic Russians made up 68.6% of the population of Bishkek, and ethnic Kyrgyz made up 9.3%. By 2009, 26% of Bishkek’s population were ethnic Russians, and 58.6% were ethnic Kyrgyz. Now, the conflict has shifted to being between the Russian and Kyrgyz “urbans” and the Kyrgyz. This means that “urban” Kyrgyz, along with ethnic Russians, now share the discomfort toward the squatter settlements surrounding the periphery of the city. They are uncomfortable seeing the makeshift housing, and point to the high unemployment rates in the squatter settlements. They view all the “newcomers” living in the periphery of the city as criminals (Flynn and Kosmarskaya, 2017). This attitude is also held against modern pastoralists, who are referred to as *kochevniki*, which is a derogatory term for ethnic groups whose origins seem to be predominantly pastoral (Kardulias, 2015). Due to Soviet and modern-day Russian influence, urban Kyrgyz have developed a sense of disgust towards their traditions, and towards the low-density makeshift settlements surrounding their city.

The situation is similar in Kazakhstan, rural to urban migrants have few resources, they lack an adequate education or the ability to buy housing, and they must engage in the informal sector of the economy. Most rural migrants are forced to find work through their family or friends (Zabirova, 2014). The largest difference between the former Soviet Socialist Republics and the Soviet influenced Mongolia seems to be that Mongolians have been able to maintain elements of their nomadic culture, and have found ways to adapt it into their lives in the city. The former Soviet states have been forced to abandon their nomadic heritage, and now they hold very negative views of rural life. Their peripheral squatter settlements are much more typical to the slums seen around the world, and are not seen as a viable place to live, as Mongolia’s *ger* districts are.

Conclusion

Urban development in the post-Soviet states, and especially Mongolia is currently not socially or economically sustainable. In all of these cities, basic public services such as sanitation, water resources, electricity, heating, and waste management are essentially nonexistent for the bulk of residents in the city. High unemployment rates leave little room for the economies of these cities to grow. Most problematic is Mongolia's policy of giving away free land to every citizen. It is not possible to build the economy through land speculation, which has proven to be very effective in the United States, Japan, and South Korea. However, these places all have vibrant informal economies; the housing market in Mongolia, as mentioned earlier, is almost entirely within the black market. So, it may be possible that these economies will be sustainable through the legitimization of informal housing and economies, which Mongolia has already made great strides in achieving, while the post-USSR states are adamantly opposed to the idea. However, it could be the key to successful urbanization in Central Asia.

Project Design

Methodology

This project primarily used GIS and mapping to analyze, organize, and present data that has been collected through remote sensing, archival sources, and economic data.

Methods

Patterns of development have been analyzed by digitizing remotely sensed time series images of Ulaanbaatar. Central city, central *ger*, middle *ger*, and fringe *ger* areas were designated according to the areas established by the City of Ulaanbaatar's master plan (Figure 4). The area of analysis was restrained to the Sukhbaatar district, as it provides a representative

intersection of the city, with the central city, center *ger*, middle *ger*, fringe *ger*, and rural outskirts all represented within the district. These areas were digitized as polygons and the structures within them were digitized as points. *Gers* and permanent structures were classified as separate feature classes. This process was completed for aerial imagery for the years 2005, 2009, 2013, and 2017. The data was analyzed for the number of permanent and *ger* structures in each district each year, the length of time each structure has existed in the area, and the mean center for *ger* and permanent structures for each year (Figures 5-8).

Economic data from sources such as the World Bank have also been utilized to gain a better understanding of the country and the city's current economic situation. Past development projects were examined in these documents and cost estimates for potential infrastructure improvements were provided. These were used along with the digitized GIS data created to propose economically viable solutions to the most pressing infrastructural problems facing Ulaanbaatar today.

Results

Ring patterns in the development of cities is a fairly basic concept in human geography. The most commonly accepted model is the Burgess model, where the CBD lies in the center of the city with a ring of business/residential area surrounding it. The next three rings after that are lower class residential, middle class residential, and upper class residential.

The results from the mean center analysis applied to the Sukhbaatar district of Ulaanbaatar suggested a different pattern. After all *ger* and permanent structures were digitized, a mean center analysis revealed that the average location of both the *ger* households and the permanent structure households have been moving away from the city center since 2005 (Figures

9-12). This is to be expected as more Mongolian citizens move from rural areas to Ulaanbaatar and settle at the periphery of the city, where land is available. However, the more surprising trend was that permanent *ger* structure mean center is moving away from the city center much more rapidly than the *gers*. This is an unexpected result because we would expect that the wealthier residents that can afford to construct permanent houses would be, or would choose to move to, a location closer to the city center, where infrastructure and services are more well established. This suggests that Ulaanbaatar has developed a ring pattern parallel to, but quite distinct from, the Burgess model. Ulaanbaatar has developed its own pattern of concentric development: a wealthy central business district and apartment area in the center, a poor inner *ger* district surrounding it, and a more structured middle-class ring representing the middle *ger* area, impoverished fringe *ger* areas surrounding it, and rural steppes surrounding the city.

So why are Ulaanbaatar's middle-class residents constructing homes in the middle fringe area, away from the services and infrastructure of the central city? The answer likely lies in the failure of Ulaanbaatar's several affordable housing programs. The Mongolian government has put forth several programs that were aimed at creating affordable housing options for Ulaanbaatar's poorest residents, including the State Housing Corporation (TOSK), the 8% mortgage program, the *ger* area redevelopment policy, the City Housing Program, the city housing program, and the *Ger* Area Housing Program. These programs, while aimed at Ulaanbaatar's low-income residents, have primarily benefitted the middle class. I propose that the radical difference in how the government values land and Ulaanbaatar's residents value land is also a major factor in the failure of these programs. Officially, one square meter of land is valued at 13,200 tugrik, which means a normal family's block of land has a value of 9,240,000 Tugrik. However, land is most commonly sold illegally, and the prices are radically different

from the official land prices that the government has set, with prices ranging from 1,000,000 to 29,000,000 tugrik for a normal block of land officially priced at 9,240,000 tugrik. it's possible that lower-income residents opt for the blocks of land in areas where housing prices are much cheaper than the official value set by the government, so the affordable housing programs-based of off official land prices-are still out of reach for employed, low income households. This means that these programs, primarily targeted towards the undeveloped middle and fringe *ger* areas, have primarily benefitted the middle-class residents of the middle *ger* areas.

Unfortunately, this has left large areas of the middle and fringe *ger* areas with a high population density, but a lack of infrastructure and services. The next portion of this research addresses potential solutions to this problem to make the city more sustainable and livable.

This section of this research focuses on three critical components of Ulaanbaatar's infrastructure: housing, transportation, and heating. Because air pollution from coal burning stoves is such a critical issue in Ulaanbaatar, creating a clean heating system for the city is vital to the health of the city. Mongolia is rich in geothermal resources with 43 hot springs (Figure 14). This geothermal activity is currently underutilized with hot springs primarily being used for bathing. greenhouses, and as tourist attractions. However, early studies on the use of geothermal heat to heat Mongolian homes and buildings are currently underway. Using advanced shallow heating pumps that are designed to move thermal energy from a source of heat to a building, a single Mongolian home can be heated for decades with virtually no negative environmental effects. Studies testing the viability of the pumps in Mongolia's subarctic environment have proven to be very successful (Sohn, 2015). Further research is needed to confirm that these pumps will be economically viable.

Before installing heat pumps into the homes of Ulaanbaatar's residents, the structures' capability to retain heat must be examined as well; it would be counterproductive to install these devices into homes that lack the capacity to retain heat, such as *gers*, therefore, it is important to focus efforts on replacing every *ger* with a well-insulated permanent structure. The World Bank estimates that the cost of building a typical Mongolian detached house is approximately 7,000 to 11,000 USD. While this cost is unaffordable for many of the *ger* districts' residents it is possible that the use of microloans could be used to create something of a "mortgage" system that would residents of the *ger* districts to build their own permanent, insulated, and heated detached house (Figures 15 and 16).

The World Bank currently offers numerous microloans to rural residents in Mongolia in an effort to help them maintain their nomadic lifestyle, however, this type of assistance for urban residents is essentially non-existent. Because the total cost for building a permanent, insulated home with a heating pump installed is about 9,000 to 12,000 USD, it is feasible for loan programs to be established through the World Bank or private financial institutions that would allow Mongolian residents to cover the upfront costs of building sustainable homes through loans. Using a 4% subsidized loan, a Mongolian resident would be able to pay off their loans to pay for their housing and heating system over a 30-year period through payments of $44 to $69 monthly. This would be approximately 24% to 33% of a *ger* district resident's average monthly income of 162 USD and would therefore be within the range of affordability for the average *ger* district resident. In addition, this would eliminate the need for *ger* district residents to continue to pay to heat their homes through coal burning stoves, which can consume over 10% of a *ger* district resident's income from September to May.

Transportation infrastructure also needs significant improvement (Figure 13). City wide improvements, including upgrading and paving a 1.2 km from micro road to TV bus terminal (136,000 USD), removing restrictions on microbus operators (95,000 USD) and providing sidewalks from the microbus (30,000 USD) would cost 261,000 USD total. These improvements would provide benefits such as Improved road conditions, more reliable and high frequency of bus service, safer walking conditions, created by sidewalks to kindergartens, access to markets, schools, health clinics, other public services and employments, and improved air quality due to the reduction of dust in roads. Improvements in the Sukhbaatar district alone would include paving and maintaining primary and residential roads, which would cost approximately 99,089 USD annually.

The total sum of all these proposed expenditures would add up to approximately 17,800,000 USD. Assuming an average *ger* district resident income of 162 USD, this would add approximately 110,000 jobs to the Sukhbaataar district job market. This would be an important step in combatting the high unemployment rates found in the *ger* districts.

Conclusion

Mongolia's history and climactic environment have made it—and by extension—its cities, unlike anywhere else in the world. Its tumultuous transition from a nomadic society, to a communist society, to a free market democracy have provided unique challenges and opportunities. At first glance, Mongolia does not seem much different from its Central Asian neighbors, however, it does have some unique advantages, particularly legal land tenure. However, if Mongolia is going to survive its transition from a rural nomadic nation to an urban one, effort must be focused on improving housing, transportation, and heating infrastructure to take advantage of its unique real estate market. With a concentrated effort on improving

infrastructure, such as the proposal outlined in this paper, Mongolia has the potential to become a strong and sustainable economy and place to live. However, if no changes are made, then the future of Ulaanbaatar and Mongolia as a whole is bleak.

Appendix

Figure 1 Map of Mongolia. Source: ESRI

Figure 2 A Kazakh Yurt. Source: UNESCO

Figure 3 A Mongol *Ger*. Source: National Geographic Society

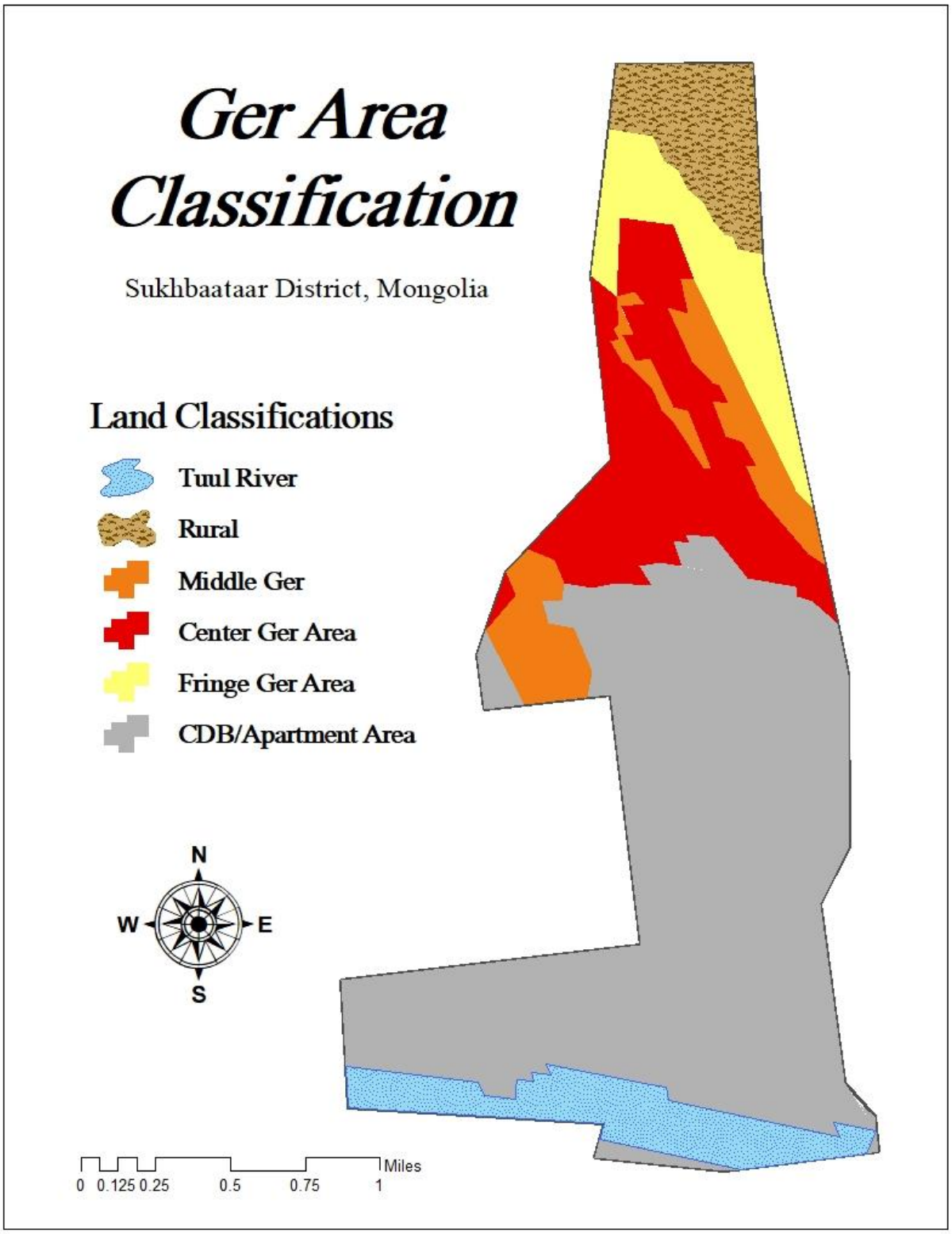
Ger Area Classification
Sukhbaataar District, Mongolia
Land Classifications
Tuul River
Rural
Middle Ger
Center Ger Area
Fringe Ger Area
CDB/Apartment Area
N
W
E
S
0 0.125 0.25 0.5 0.75 1
Miles

Figure 4

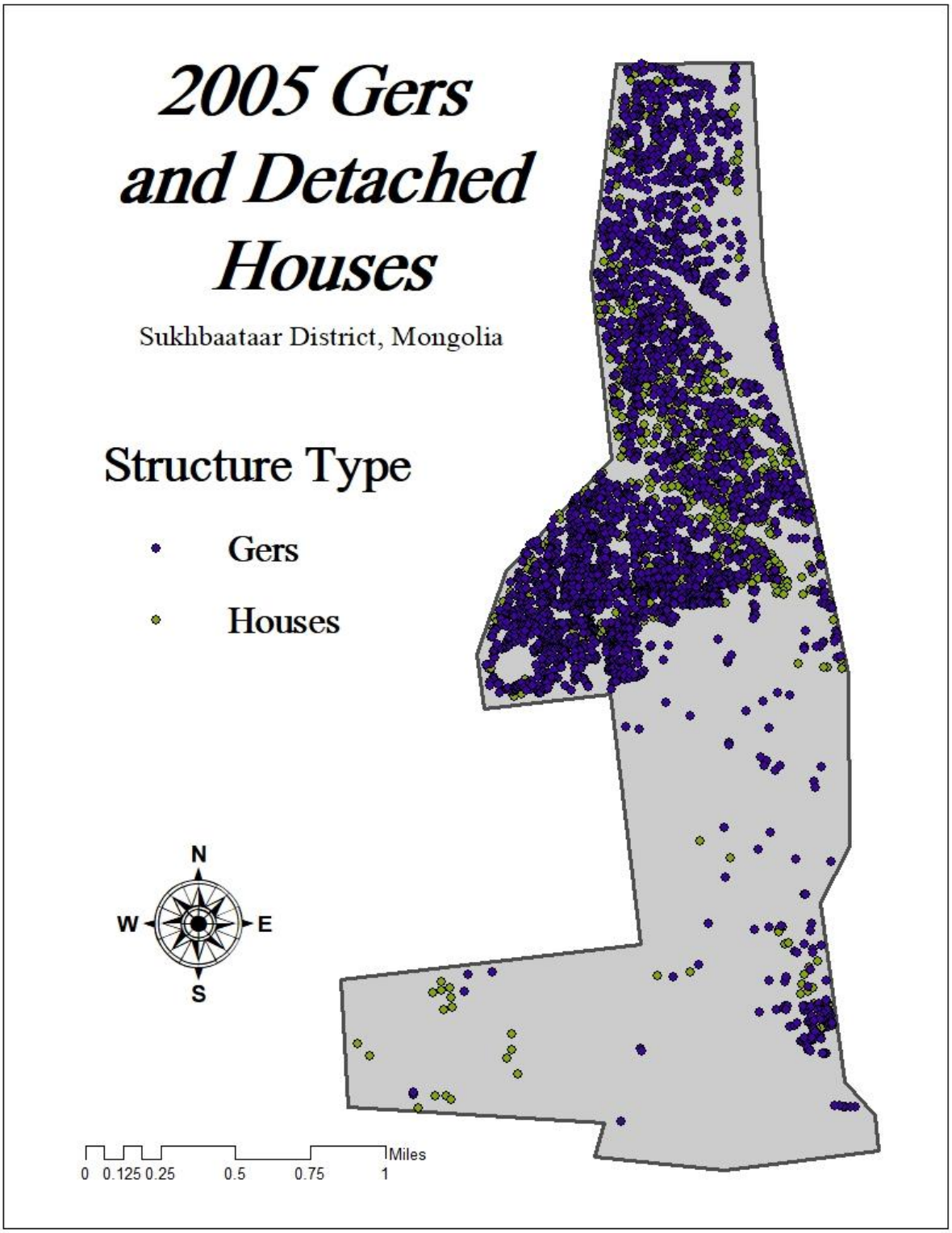
2005 Gers and Detached Houses
Sukhbaataar District, Mongolia
Structure Type
Gers
Houses
N
W
E
S
0 0.125 0.25 0.5 0.75 1
Miles

Figure 5

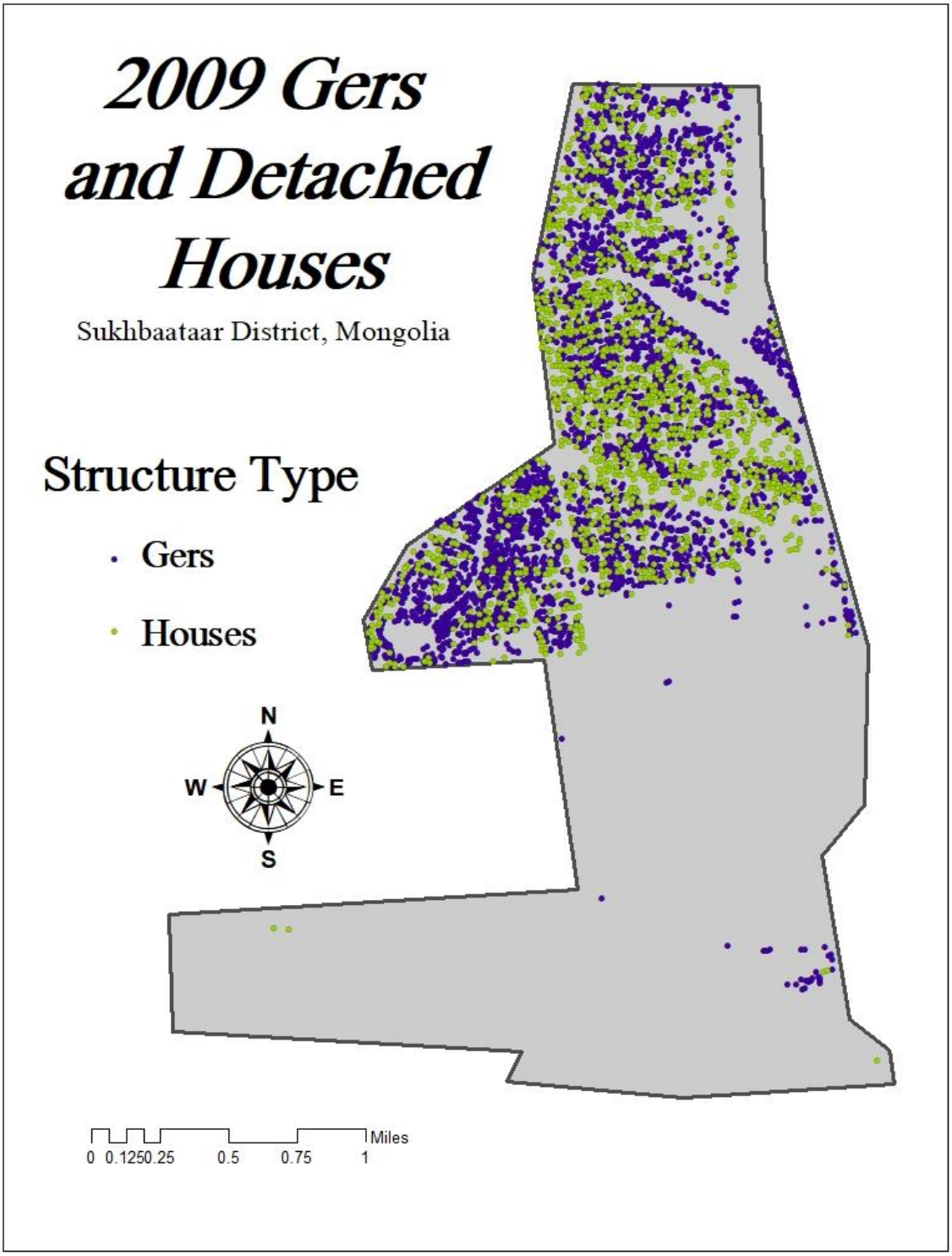
2009 Gers and Detached Houses
Sukhbaataar District, Mongolia
Structure Type
Gers
Houses
N
W
E
S
0 0.1250.25 0.5 0.75 1
Miles

Figure 6

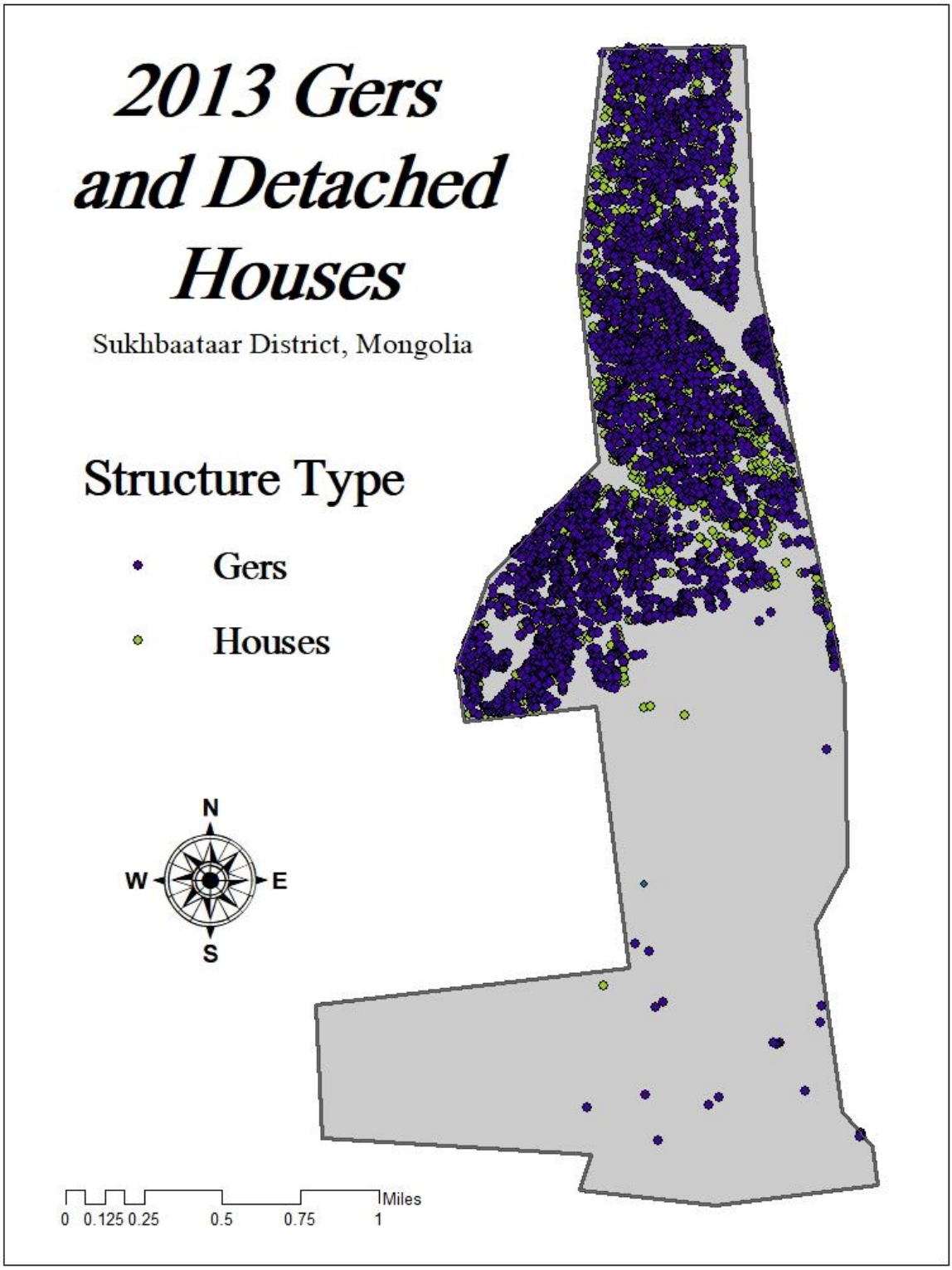
2013 Gers and Detached Houses
Sukhbaataar District, Mongolia
Structure Type
Gers
Houses
N
W
E
S
0 0.125 0.25 0.5 0.75 1
Miles

Figure 7

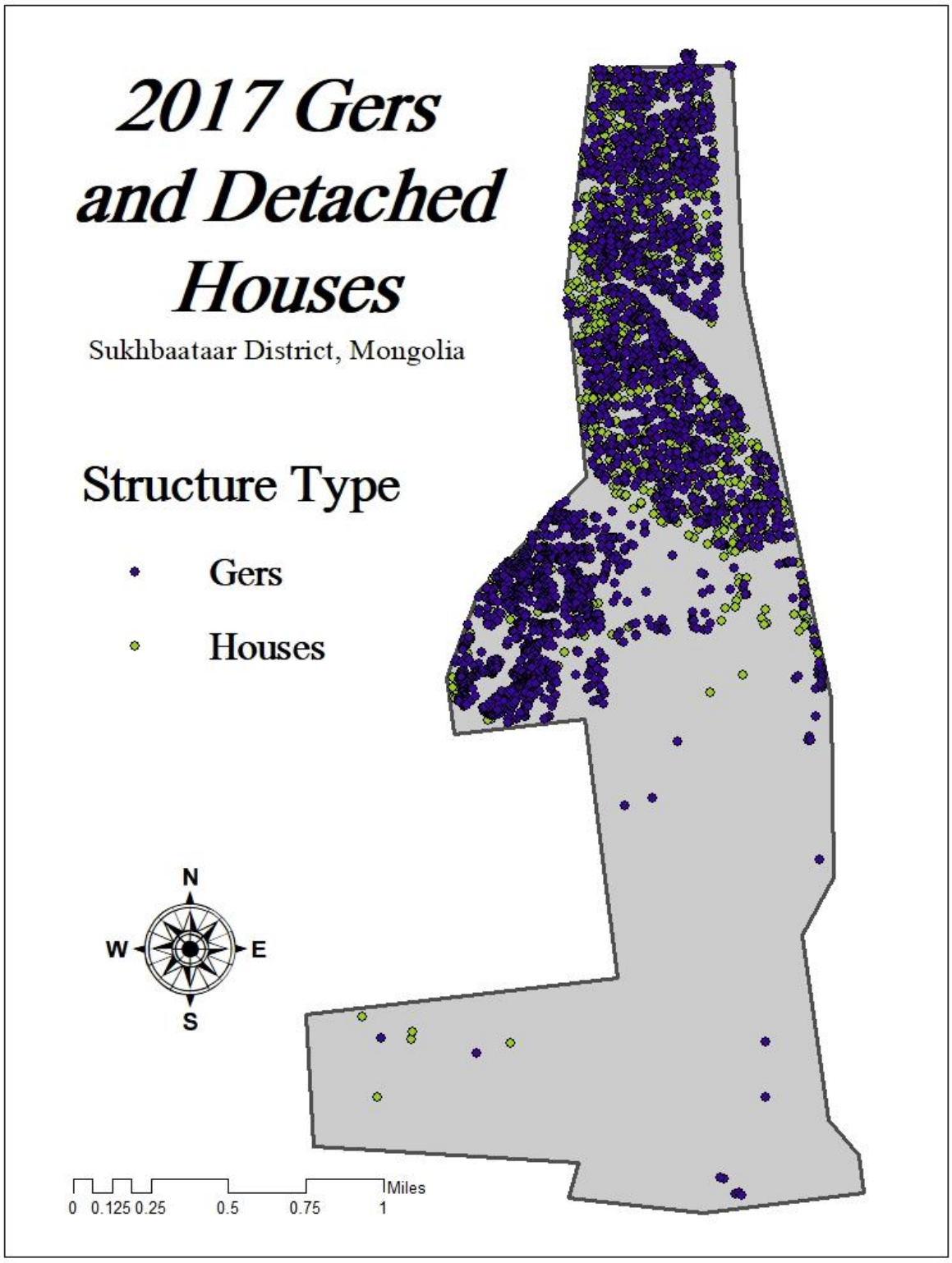
2017 Gers and Detached Houses
Sukhbaataar District, Mongolia
Structure Type
Gers
Houses
N
W
E
S
0 0.125 0.25 0.5 0.75 1
Miles

Figure 8

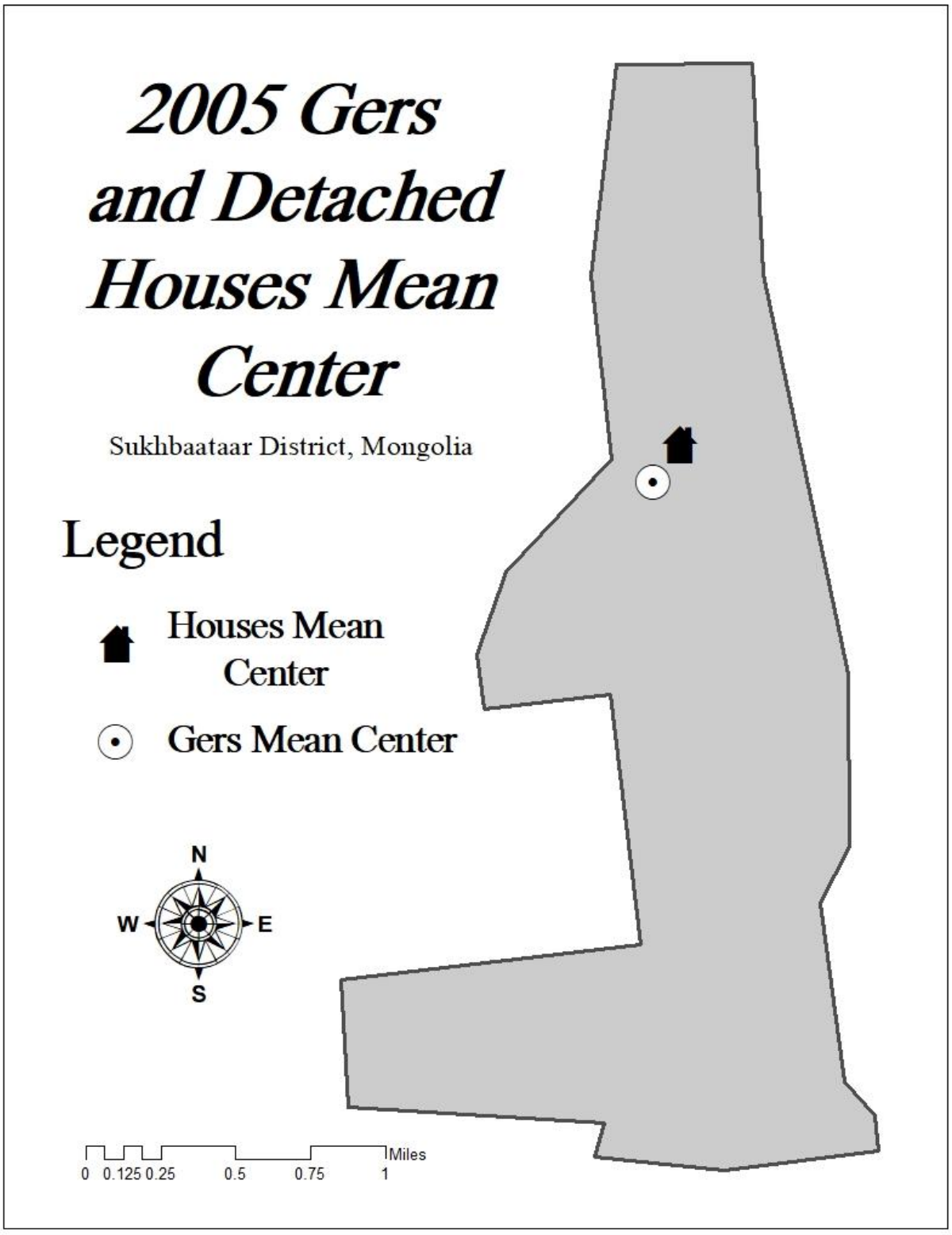
2005 Gers and Detached Houses Mean Center
Sukhbaataar District, Mongolia
Legend
Houses Mean Center
Gers Mean Center
N
W
E
S
0 0.125 0.25 0.5 0.75 1
Miles

Figure 9

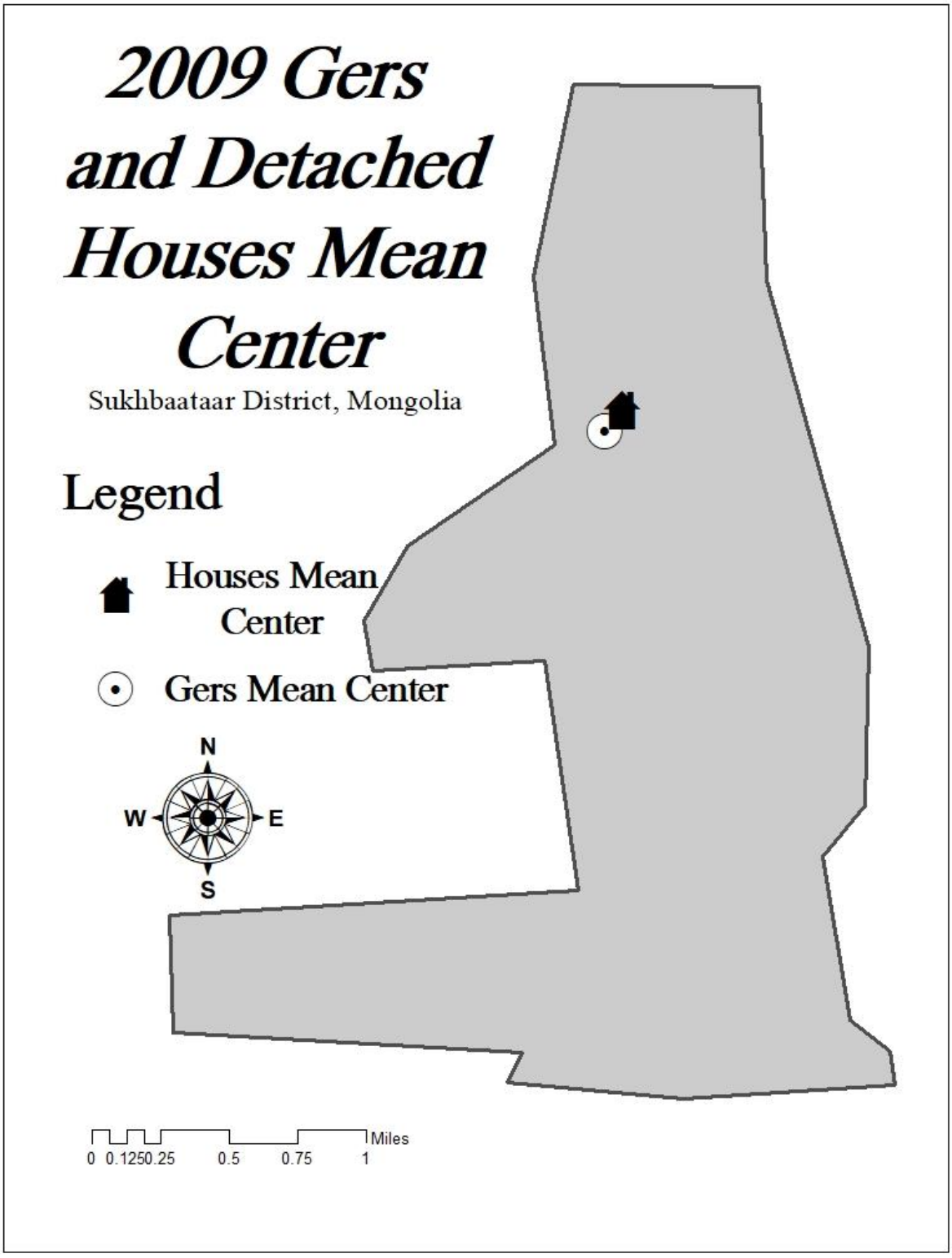
2009 Gers and Detached Houses Mean Center
Sukhbaatar District, Mongolia
Legend
Houses Mean Center
Gers Mean Center
N
W
E
S
0 0.1250.25 0.5 0.75 1
Miles

Figure 10

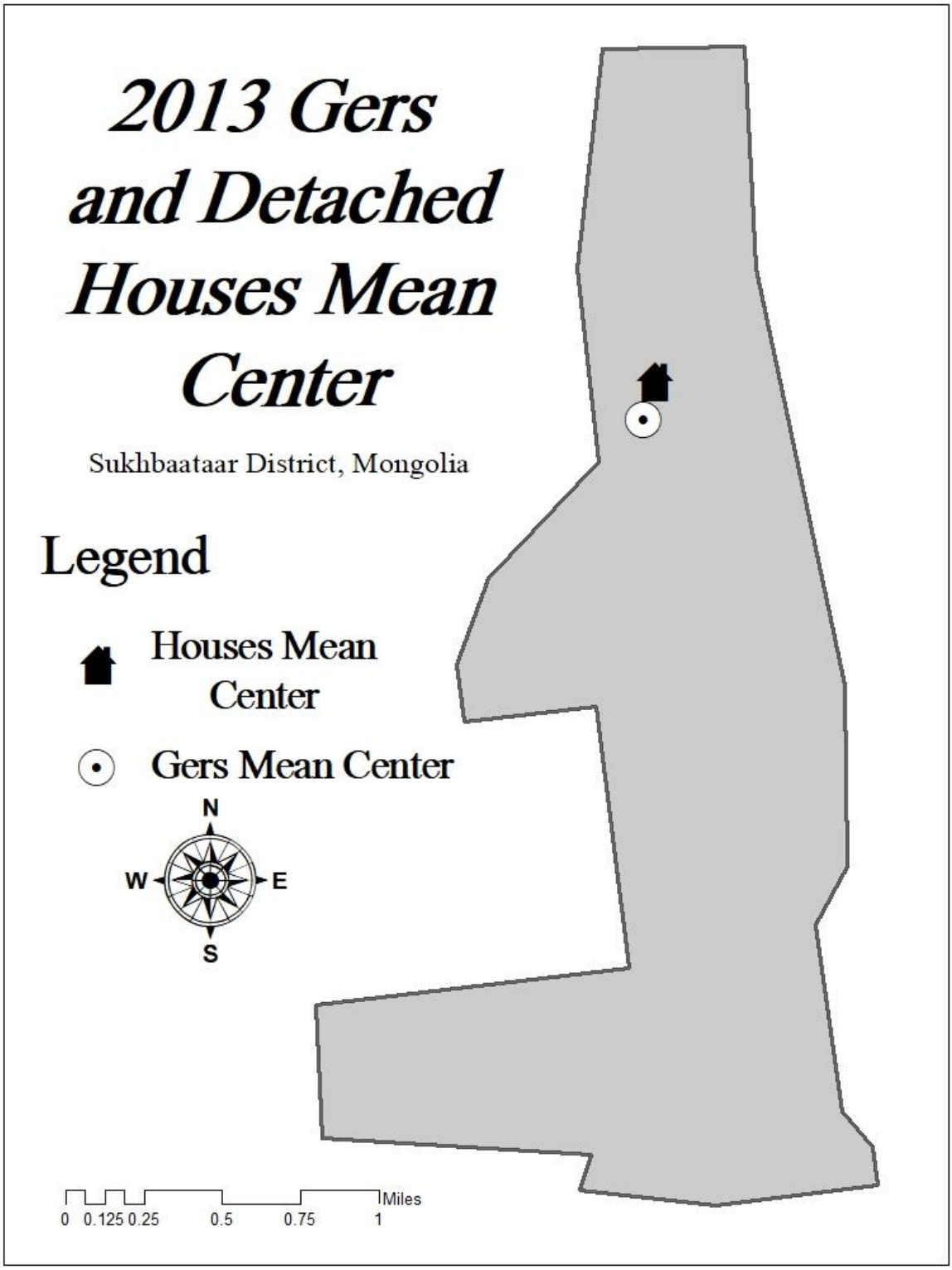
2013 Gers and Detached Houses Mean Center
Sukhbaataar District, Mongolia
Legend
Houses Mean Center
Gers Mean Center
N
W
E
S
0 0.125 0.25 0.5 0.75 1
Miles

Figure 11

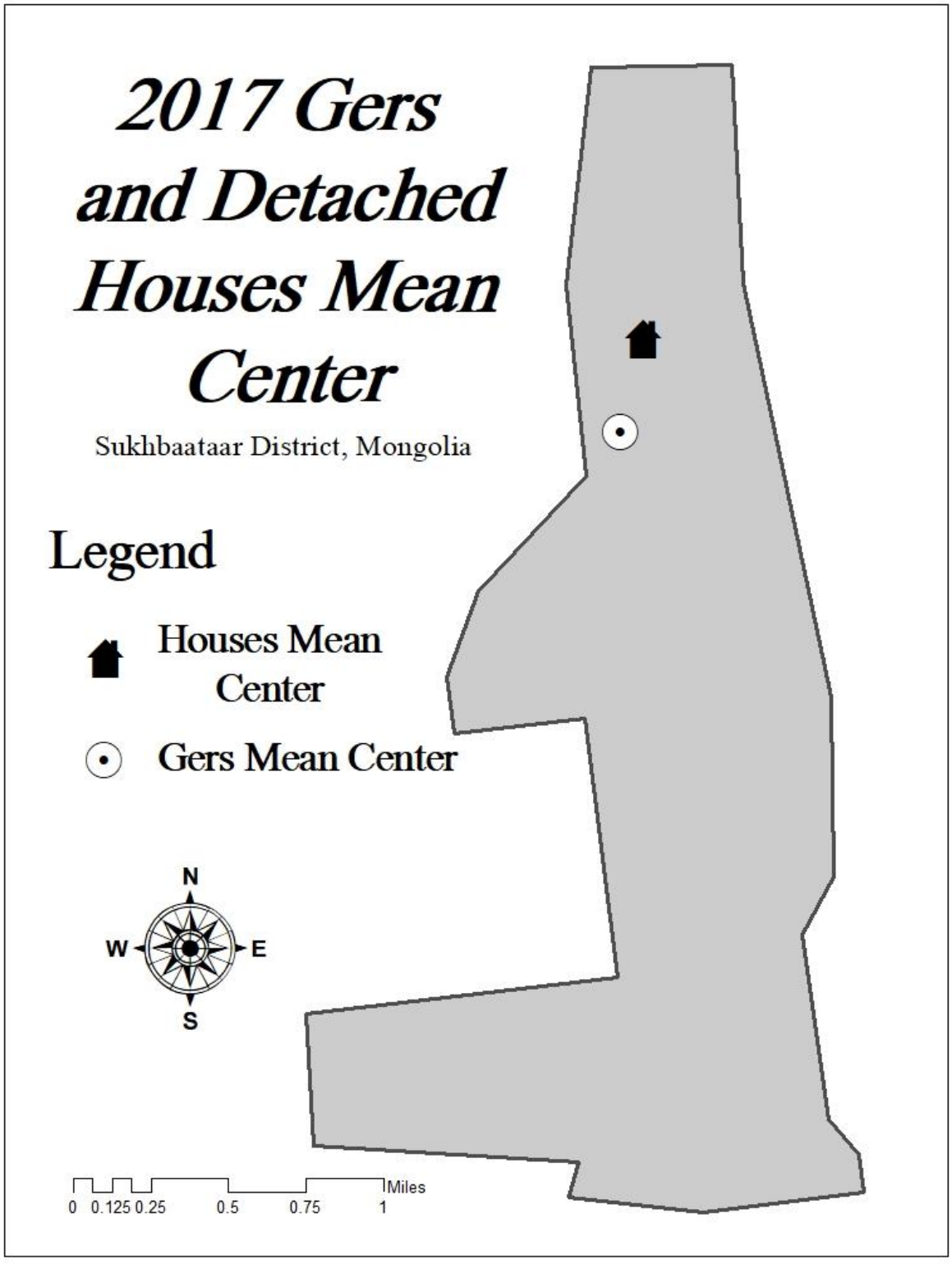
2017 Gers and Detached Houses Mean Center
Sukhbaataar District, Mongolia
Legend
Houses Mean Center
Gers Mean Center
N
W
E
S
0 0.125 0.25 0.5 0.75 1
Miles

Figure 12

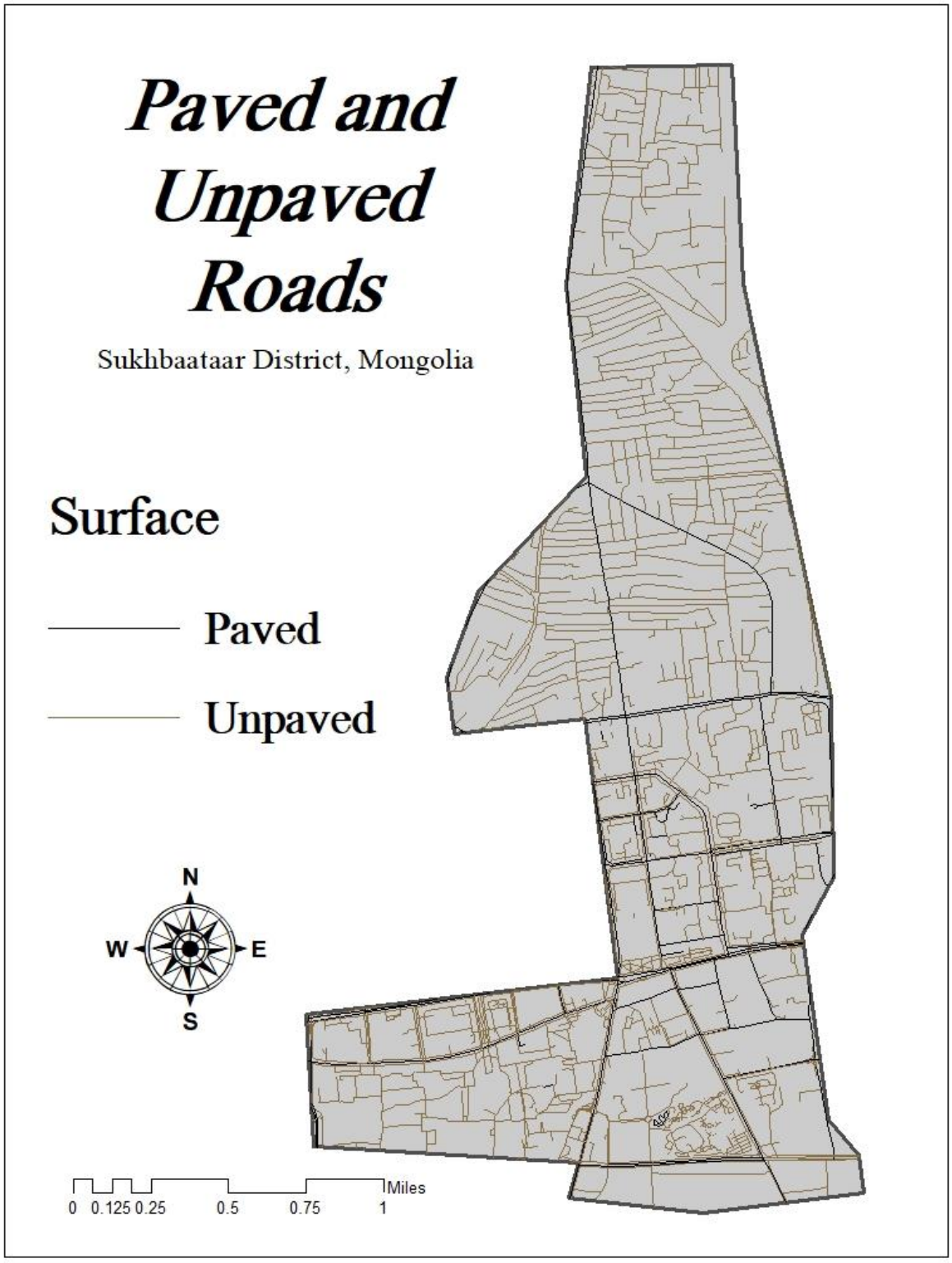
Paved and Unpaved Roads
Sukhbaataar District, Mongolia
Surface
Paved
Unpaved
N
W
E
S
0 0.125 0.25 0.5 0.75 1
Miles

Figure 13

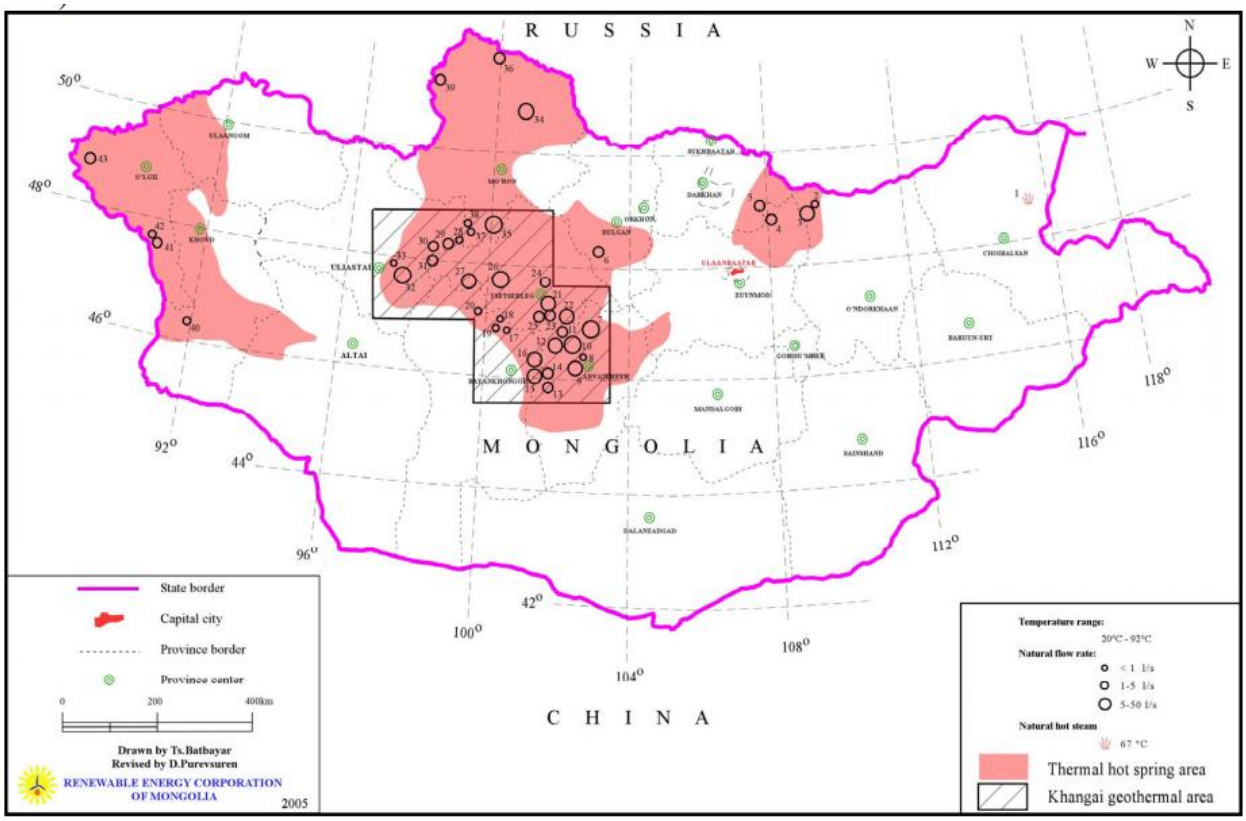

Figure 14, Source: Ganzorig Shagdarsuren

District	Number of Gers	Cost per House (million Tg)	Total Cost (million Tg)	Cost of land per House (million Tg)	Total Cost of land (million Tg)	Cost per House (USD)	Total Cost (USD)	Cost of land per House (USD)	Total Cost of land (USD)
Central	976	28.97	28274.72	29	28304	10,124	11,833,253	12,136.79	11,845,507.04
Middle	458	17.59	8056.22	9.24	4231.92	7,362	3,371,609	3,867.03	1,771,100.84
Fringe	284	18.69	5307.96	1	284	7,822	2,221,434	418.51	118,856.84

Figure 15

Cost of Pump (USD)	Cost of House + heating (USD)	Average Monthly income (USD)	Approximate Amount of income used for heating (September to May) (USD)	Monthly payment on loan to cover cost on house and geothermal heating system with a 30-year mortgage (USD)	Percent of Monthly income
1500	9,322	184	13.8	($44.50)	24.18
1500	9,322	136	10.2	($44.50)	32.72
1500	9,322	166	12.45	($68.40)	24.18

Figure 16

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