# Public space capacity estimations during COVID-19 pandemic using geospatial analysis: A case study of Naresuan University, Thailand

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## ABSTRACT

*As many provinces in Thailand have eased lockdown restrictions to combat the COVID-19 pandemic, people are returning to their daily lives. Unfortunately, because of the growing use of public spaces, this often leads to an increase in illnesses. This raises problems regarding how to avoid premature lockdowns and how to regulate spatial distance in different regions throughout the epidemic. Although the need for a COVID-19 vaccine is critical for disease control, limiting measures in areas such social distancing in public venues with limited capacity are equally vital. This study aims to use GIS analysis to implement appropriate social distancing protocols and capacity estimations of public space areas, both indoor and outdoor, in Naresuan University, which incorporate approximately 2-meters between individuals in determining how many people should be let in to access a given space allowing some space for people to move around. The study finds that GIS can greatly contribute to planning safer ways to open recreational and public space areas and to adhere for social distancing guidelines during the pandemic.*

## 1. INTRODUCTION

The COVID-19 pandemic is riddled with unknowns, many of which have a spatial dimension that leads to a geographic and potentially mappable knowledge of the outbreak. Thus, in health science, research needs include the ability to analyze the COVID-19 phenomena using several types of variables, spatial analysis and spatiotemporal aspects, geographic influence on decision-making and everyday life, and predictive modeling of the disease's evolution. With the classification of COVID-19 as a global pandemic, the use of geospatial and statistical technologies has become even more important.

This COVID-19 theme necessitates interdisciplinary analysis, and geography is one of the few disciplines that claims to provide a synthetic approach to the interplay between biophysical and human variables (Turner, 2002), by approaching the environment from a holistic perspective and focusing on the forms and processes that coexist in a geographical space (Sauer, 1925). These are placed in a geographical, territorial, locational, and landscape context by geography. The environment-society dialectic must be understood in the perspective of geography's integrative approach (Pattison, 1964).

This study aims to use analysis to implement appropriate social distancing protocols and capacity estimations of public space areas, both indoor and outdoor, in Naresuan University, which incorporate approximately 2-meters between individuals in determining how many people should be let into access a given space allowing some space for people to move around. The study finds that GIS can greatly contribute to planning safer ways to open recreational and public space areas and to adhere for social distancing guidelines during the pandemic.

## 2. METHODS AND STATISTICAL ANALYSIS

## 2.1 Study area

Naresuan University (NU) is one of a well-recognized government universities located in Phitsanulok Province, northern Thailand. It was established on 29 July 1990, which was named after the King Naresuan the Great. The university has about 20,000 full-time students. The university has an area of 2.08 square kilometers.

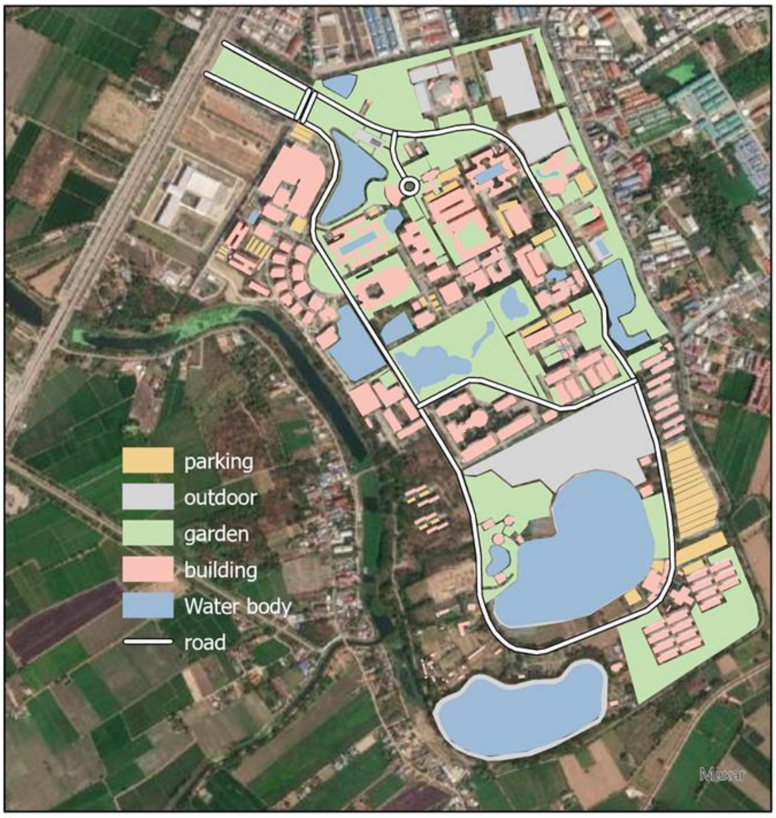


**Figure 1**. Naresuan university map

## 2.2 Data collection

Seven outdoor spaces across the university were identified based on satellite imagery and shapefile polygons were created and calculated the areas ArcGIS Pro as a tool (Figure.1).

## 2.3 Data analysis

Social distancing, or physical distancing, means limiting close contact with people we don't live with, both indoors and outdoors. It's one of the best tools we must prevent the spread of COVID-19, even if ones have been vaccinated.

One-meter social distancing is recommended by China, Denmark, and France; 1.5 meters by Australia, Germany, and Italy; and six feet, or 1.8 meters, by the United States. Meanwhile, the United Kingdom has announced that it will relax its policy, which has been criticized by leading scientists. When it comes to coronavirus, the truth is that we don't yet know how far is too far. The virus was identified in the air as far as four meters away from sick patients in a COVID-19 unit, according to a recent study. However, according to a research cited by the WHO, the chance of transmission decreases dramatically with one meter or more from an infected individual and decreases even more with additional distance. In this study we adapted the 1.8 meters rule as our analysis according to US CDC. For this work, bubbles that allowed for efficient 2-meter social distance in public space were intended to be created (Figure 2.)

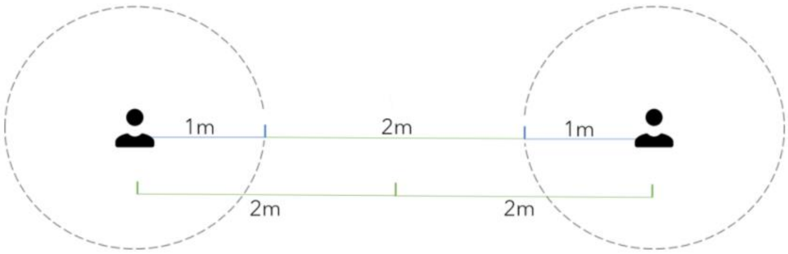


**Figure 2**. Diagram of efficient 2-meter social distance in public space bubbles.

**Figure 3**. Efficient 2-meter social distance in public space circle. (Courtesy: Shutterstock/elenabsl)

Firstly, the public spaces were selected (Figure 4a) then the Generate Tessellation tool was used to create a series of hex grids across the public space areas (Figure 4b). The area of the Generate Tessellation tool area is defined as $13.856m^2$ to create a 2m distance between each bubble.

Then the Feature to Point tool was applied to identify a point feature in the center of each hexagon (Figure 4c). 1m buffer using the Buffer tool was created using point feature function (Figure 4d). This results in a series of evenly spaced circles representing a social distance, with a 2m gap between each circle (Figure 4e). Finally, buffer polygons were clipped to the selected areas and removed the hex grid (Figure 4f).

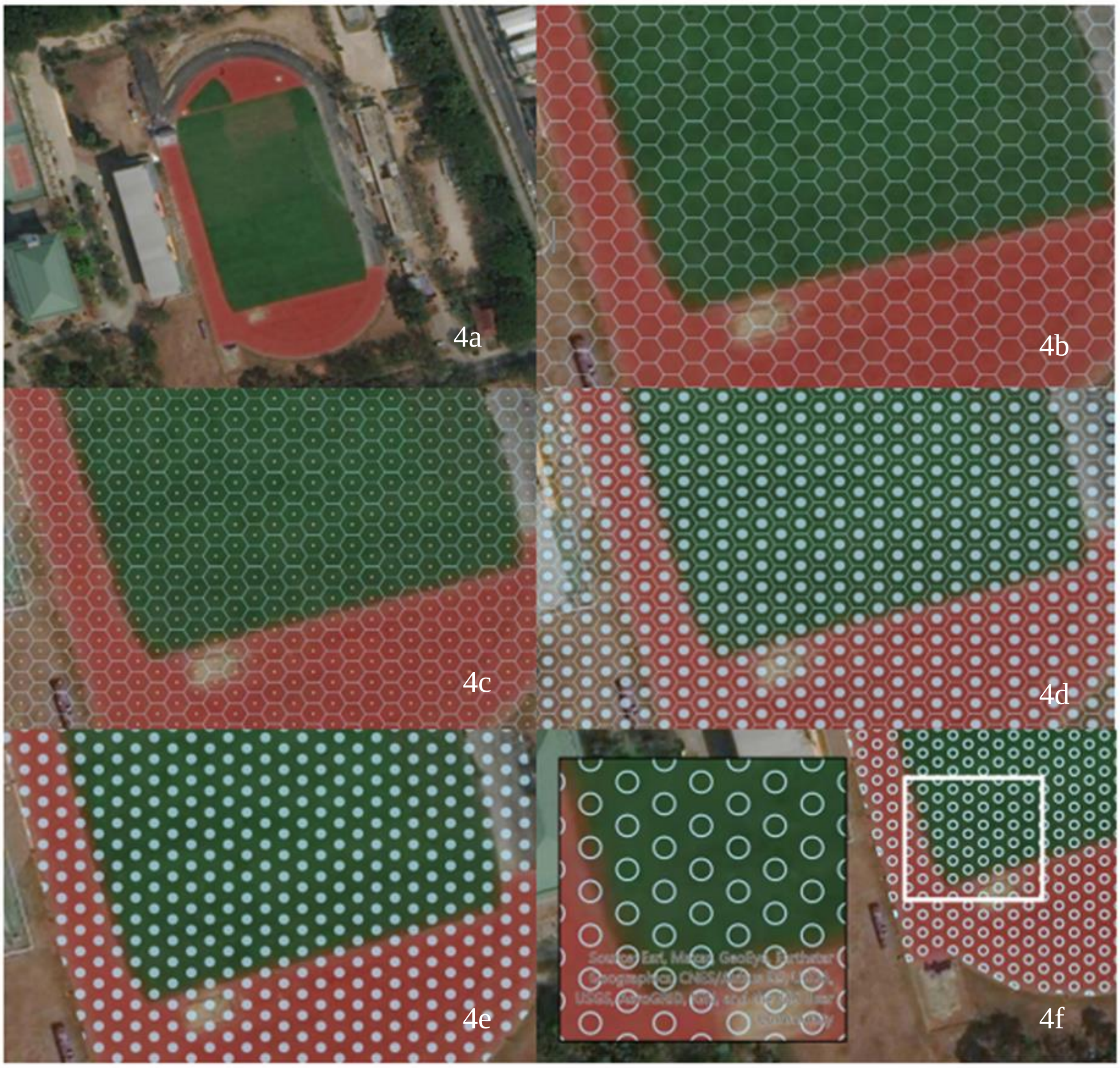


**Figure 4.** Steps of efficient 2-meter social distance in public space bubbles creation using GIS.

## 3. RESULT AND DISCUSSION

The analysis found that the BEC Football Field space has the biggest area of 16,450 m2 which allows 1,170 people to use the space under the 2m distancing rule at a specific time. NU Main Stadium has the area of 14,980 m2 with 1,070 people followed by NU Plaza Track, Reservior Running Track, NU Track, King Naresuan Statue, and Outdoor Performance Space, recpectively. This analysis limits the use of public space at around 22 percent of the total area during the COVID-19 pandemic.

**Table.1** Place names and public space limit of each open areas in Naresuan University

| ID | Place Name | Area (m2) | Public Space Limit (person) | Public Space Limit Area (m2) | Public Space Limit (%) |
|---|---|---|---|---|---|
| 1. | BEC Football Field | 16,450 | 1,170 | 3,580 | 21.8 |
| 2. | NU Main Stadium | 14,980 | 1,070 | 3,260 | 21.8 |
| 3. | NU Plaza Track | 8,970 | 830 | 1,945 | 21.7 |
| 4. | Reservior Running Track | 7,865 | 730 | 1,720 | 21.9 |
| 5. | NU Track | 5,080 | 460 | 1,120 | 22.0 |
| 6. | King Naresuan Statue | 2,260 | 170 | 490 | 21.7 |
| 7. | Outdoor Performance Space | 1,930 | 140 | 420 | 21.8 |

## 4. CONCLUSION

The study finds that the simple analysis of GIS can greatly contribute to planning safer ways to open recreational and public space areas and to adhere for social distancing guidelines during the pandemic. In other words, when assessing how many people should be allowed into a given space, authorities could benefit from utilizing estimates for social distance that include roughly 2-meters, or about six feet, between persons. Given the spatial dimensions and total area for public space at the institution, authorities should apply social distancing to assess the number of people they can accommodate. This would help to prevent or at the very least minimize huge gatherings from becoming possible super spreader events, which might quickly increase infection rates.

## 5. REFERENCES


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