UTILIZING GIS TECHNIQUESFOR STUDYING SPATIAL DISTRIBUTION PATTERNS OF GREEN LOGISTICS ACTIVITIES UNDER PANDEMIC SITUATION: A CASE STUDY IN THAILAND

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ABSTRACT: This paper aims to use Geographical Information System (GIS) techniques for studying spatial distribution patterns of green logistics activities at tourist attractions to current COVID-19 situation in Muang Nakhonratchasima district, Thailand. Forty Nine purpose based questionnaires were collected online between 1 April – 31 July 2021. This data was spatially analyzed using high/Low clustering Getis-Ord General G in ArcGIS program. The overall score of 8 green logistics activities in 12 tourist attractions in Muang Nakhonratchasima district is 1.89, which is at a low level. However, almost all tourist places have a high level of green awareness with the exception of Phanomwan Castle (low level). The result reveals that the green logistics activities pattern was neither a clustered or dispersed pattern, which also refers to as a normative distribution pattern in such 12 tourist attractions of Muang Nakhonratchasima district. Both public and private organizations has realized to reverse logistics using a barcode, electric email, and information online for facing the current COVID-19 situation. Consequently, the obtained results will be suggested for TAT Nakhonratchasima and the office of Nakhonratchasima City Municipality further.

1. INTRODUCTION

According to the United Nations World Tourism Organization (UNWTO) report, the world tourism is facing the impact of the COVID-19 pandemic that has continued since the end of 2019 as every country has adopted inter-travel restrictions to prevent the spread of COVID-19. As a result of the COVID-19 situation, the global tourism industry has decreased in the first quarter of 2020, with the number of international tourists dropping 22.7% (Ministry of Tourism & Sports., 2020a). The number of international tourists only in March has decreased 97% only in March of year 2020, compared to the same month in 2019 (Ministry of Tourism & Sports., 2020b). As with the tourism situation in Thailand, the pandemic incident has resulted in the number of foreign tourists traveling to Thailand in the first quarter of 2020 decreased by 38.0% compared to the same period of 2019 (Tourism Authority of Thailand, 2020). Therefore, Thai tourism shifts strategy for learning to live with COVID-19 as well as suggestions on strategies for adapting the tourism sector for Thailand's response to the new way in the future. Guidelines are suggested for promoting tourism after lockdown measures are more relaxed such as preparation of the tourism industry to support the restarting of responsible tourism. One of the guidelines is environmental development that is taken into account environmentally friendly logistics management or called 'Green Logistics' Activities.' Currently, leading companies, large and small, are looking for ways to go green so as to reduce emissions, make the businesses more sustainable and ultimately move toward a Circular Economy (DHL, 2020). This is a reason why this study has taken interest in green logistics activities. Generally, green logistics refers to the set of sustainable policies and measures aimed at reducing the environmental impact caused by the activities of this business area (Interlake Mecalux, 2019). Best practices of green logistics activities can help a more sustainable balance between economic, environmental, and social objectives (Bradley, 2021). Furthermore, GIS software lets you produce maps and other graphic displays of geographic information for analysis and presentation (Caliper, 2021). GIS applications, decision-makers can edit spatial and geographic data in maps, analyze this data by creating interactive searches and visualize the conclusions of these processes (Balaman, 2018). Moreover, GIS application was used in computing the density of a spatial pattern such as the locations of residential burglaries or road accidents (Charlton,2009).

Thus, this study requires current spatial pattern and distribution of green logistics' activities under pandemic situation

in tourism places of Muang Nakhonratchasima district, Thailand. This work presented Geographic Information System (GIS) technique for analyzing the spatial pattern and distribution of green logistics' activities. Importantly, the results obtained will put insight into the green logistics activities in tourist attractions in Muang Nakhonratchasima district during COVID-19 pandemic situation. In addition, this information will help for developing and promoting tourism strategies in Muang Nakhonratchasima district to improve tourism industries whether there will be pandemic situation such as the COVID-19 or not in the future.

2. STUDY AREA

The study area consists of twelve tourism destinations in Muang Nakhonratchasima district, Nakhon Ratchasima province, Thailand as recorded by the office of Tourism Authority of Thailand (TAT) Nakhonratchasima (2015). The twelve-tourist attraction locates between 14°-16°N latitude and 101°-103°E longitude (Figure 1). Additionally, these tourism places are 1) Thao Suranaree Monument and Chumphon Ancient Gate (TSMCAG), 2) Maha Weerawong National Museum (MWNM), 3) Phanomwan Castle (PC), 4) Khorat Fossil Museum (KFM), 5) Sirindhorn Learning Park (SLP), 6) Nakhonratchasima Regional Observatory for the Public (NROP), 7) Korat Water Park (KWP), 8) Arts of Korat Mirage Museum (AKMM), 9) Nakhonratchasima Zoo (NKZ), 10) Pa Salawan Temple (ST), 11) Sala Loi Temple (SLT), and 12) Sala Thong Temple (STT). Within Mueang district, six tourism places are in Ni Muang sub-district, four tourism places are in Suranaree sub-district, and one tourism place is in Ban Pho and Chaimongkol sub-district.
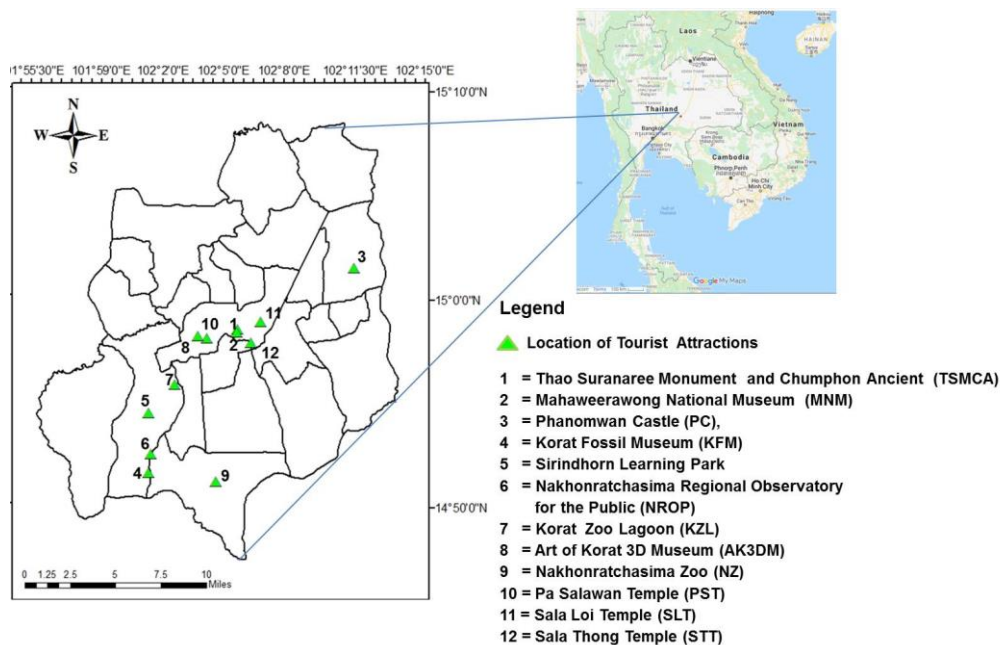

Figure 1 Twelve-tourism place in Muang Nakhonratchasima district, Nakhon Ratchasima province, Thailand

3. MATERIALS AND METHODOLOGY

3.1 Data collection

Online questionnaire survey was conducted using a structured questionnaire which was modified from the research project named, 'Geoinformatics Technology for Spatial Pattern and Distribution of Green Logistics' Activities in Tourism Place of Muang District, Nakhon Ratchasima Province', funded by Thailand Science Research and Innovation (TSRI)) in the year 2016. The online questionnaire was designed to ask entrepreneurs in the study area with rating and scoring of 8 green logistics activities: Green Purchasing, Green Production, Green Transportation, Green Packaging, Green Inventory, Green Technology, Green Awareness, and Green Service. Measuring the rate and score of green logistics activities consist of 5 levels: the highest level with a score of 5, the high level with a score of 4, the moderate level with a score of 3, the low level with a score of 2 and the lowest level with a score of 1. The survey used purposive sampling strategy because the researcher required their own decision based on consideration of characteristics of the selected group in accordance with the research objectives, and selecting a specific sample requires knowledge, expertise, and experience in that subject of the researcher. With the COVID-19 situation, these questionnaires were sent by email and then were returned within periods of 3 months (from April to June 2021). This

study selected 49 respondents including 12 people, who are responsible for the tourist attraction, and 37 entrepreneurs, who are focused on food shops or grocery stores with ready-to-eat fresh food in 12 tourist attractions of Muang Nakhonratchasima district as shown in Table 1.

Table 1 The 49-entrepreneur in 12 tourist attractions of Muang Nakhonratchasima district, Thailand

No.	Tourist attractions	Quantity of entrepreneur
1*	Thao Suranaree Monument and Chumphon Ancient Gate	9
2*	Maha Weerawong National Museum	1
3*	Phanomwan Castle	2
4*	Khorat Fossil Museum	4
5**	Sirindhorn Learning Park	1
6**	Nakhonratchasima Regional Observatory for the Public	1
7**	Korat Water Park	8
8**	Arts of Korat Mirage Museum	1
9**	Nakhonratchasima Zoo	19
10*	Pa Salawan Temple	1
11*	Sala Loi Temple	1
12*	Sala Thong Temple	1
	Total	49

Remark: *Govern agencies and **Private agencies

1.2 Data analysis

This study analyzed spatial distribution patterns of green logistics activities in 12-tourism place of Muang Nakhonratchasima district under the pandemic situation. This analysis included steps as follows:

Step 1: Preparing data included (i) attribute data-based returned questionnaires in form of spread sheets and (ii) creating point-GIS layer of 12-tourism place of Muang Nakhonratchasima district.

Step 2: Joining tables between (i) and (ii) in step 1 using tools in the ArcGIS program.

Step 3: Analyzing spatial distribution patterns of green logistics activities in the 12-tourism places of Muang Nakhonratchasima district. This study used High/Low clustering Getis-Ord General G in ArcGIS program for analyzing spatial distribution patterns (this technique can explain about spatial distribution patterns of objects as follows (Geog, 2020): (1) Clustered occurs when objects exist in close proximity to one another, (2) Dispersed: occurs when objects are spread out from one another, and (3) Random: occurs when objects exist in neither a clustered or dispersed pattern. This is what we also refer to as a "hypothetical" or "normative" pattern.

4. RESULTS

4.1 Scoring and grading for activities of green logistics

This study was conducted during the epidemic situation because we want to know about the impact of lock down measures in tourist attractions in Mueang Nakhon Ratchasima district especially green logistics activities. This study surveyed and measured rate and score from online questionnaires, are returned by 49 entrepreneurs of 12 tourist destinations of Muang Nakhonratchasima district as in Table 2. In all 12 tourist destination, there were score and rate of 8 green logistic activities from 0.63 (lowest) to 3.54 (high) or average 1.89 (low). Korat Water Park has the highest scoring (3.54 or high rate) and Pa Salawan temple, Sala Loi temple and Sala Thong temple have the lowest scoring (0.63 or lowest rate). Especially, green awareness is in high rate in almost tourism places except Phanomwan Castle (low rate). These results explore that most entrepreneurs are more interested in environment. In addition, all entrepreneurs did not have responded about green inventory but they gave reasons that, in the current pandemic situation, they did not dare to order products or goods to hoard. The reasons for overall green logistics activity are in low rate because the 7-tourism places such as Maha Weerawong National Museum, Sirindhorn Learning Park, Nakhonratchasima Regional Observatory for the Public, Arts of Korat Mirage Museum, Pa Salawan temple, Sala Loi Temple, and Sala Thong Temple are closed during periods of surveying until they are permitted to open from office of Nakhonratchasima province. Thus, they cannot respond to 6 green logistics activities such as green purchasing, green production, green transportation, green packaging, green inventory, and green technology. Some tourism places are allowed to operate but they are under the lockdown regulations like time for opening and closing each day, etc. In addition, only green awareness is applicable and scored for three temples area as they are the Monk's places and carry out the religious activities of Buddhists. Thai people and other visitors can visit there for sightseeing

purposes only.

Table 1. Scoring and grading for 8-green logistics activity of 12-tourist attraction in Muang Nakhonratchasima District

Tourist attraction	green logistics activities								Score	Grade
	GPur	GPro	GTran	GPac	GI	GTec	GA	GS		
1. Thao Suranaree Monument and Chumphon Ancient Gate	3.52	3.78	3.44	3.56	0	4.78	5.00	3.33	3.43	Middle
2. Maha Weerawong National Museum	0	0	0	0	0	0	5.00	5.00	1.25	Lowest
3. Phanomwan Castle	2.25	2.50	2.50	2.50	0	2.50	2.50	2.50	2.16	Low
4. Khorat Fossil Museum	3.31	3.67	3.19	3.00	0	5.00	5.00	3.50	3.33	Middle
5. Sirindhorn Learning Park	0	0	0	0	0	0	5.00	4.00	1.13	Lowest
6. Nakhonratchasima Regional Observatory for the Public	0	0	0	0	0	0	5.00	5.00	1.25	Lowest
7. Korat Water Park	3.96	3.79	3.88	3.56	0	4.75	5.00	3.38	3.54	High
8. Arts of Korat Mirage Museum	0	0	0	0	0	0	5.00	5.00	1.25	Lowest
9. Nakhonratchasima Zoo	3.72	3.79	3.84	4.08	0	4.05	4.11	4.16	3.47	Middle
10. Pa Salawan Temple	0	0	0	0	0	0	5.00	0	0.63	Lowest
11. Sala Loi Temple	0	0	0	0	0	0	5.00	0	0.63	Lowest
12. Sala Thong Temple	0	0	0	0	0	0	5.00	0	0.63	Lowest
Score	1.40	1.46	1.40	1.39	0.00	1.76	4.72	2.99	1.89	
Grade	Lowest	Lowest	Lowest	Lowest	Lowest	Low	High	Middle	Low	

Remark: - GPur = Green Purchasing, GPro = Green Production, GTran = Green Transportation, GPac = Green Packaging, GI = Green Inventory, GTec = Green Technology, GA = Green Awareness (GA), and GS = Green Service
- Scoring and grading included lowest between 0.00-1.49, low between 1.50-2.49, middle between 2.50-3.49, high between 3.50-5.00 and highest between 4.50-5.00
- Average score of each tourism place is the average of all scores given by entrepreneurs for all 8-green logistics activities

4.2 Pattern for spatial distribution of green logistics activities

The spatial distribution pattern of 8-green logistics activity in 12-tourism place of Muang Nakhonratchasima district is totally in random pattern, reveals scoring of green logistics activities exist in neither a clustered or dispersed pattern. This is refer as a "hypothetical" or "normative" pattern in such 12 tourist attractions, Muang Nakhonratchasima district as Figure 2(1). Spatial Analysis of 8 green logistics activities in 12 tourist attractions of Mueang Nakhon Ratchasima district can be explained as follows:

1) Green purchasing (as shown Figure 2(2)) is spatially analyzed as random distribution pattern with overall of average score 1.40 or lowest level. This activity has a range of scoring and grading from 2.25 (low) to 3.96 (high). The high level of green purchasing is seen by 3 tourist attractions such as Korat Water Park, Nakhonratchasima Zoo and Thao Suranaree Monument and Chumphon Ancient Gate; the middle level is seen by 1 tourist attraction such as Khorat Fossil Museum; the low level is seen by 1 tourist attraction such as Phanomwan Castle.

2) Green production (as shown Figure 2(3)) has random distribution pattern with overall average score of 1.46 or lowest level. This activity has a range of scoring and grading from 2.50 (middle) to 3.79 (high). The high level of green production is seen by 4 tourist attractions such as Nakhonratchasima Zoo, Korat Water Park, Thao Suranaree Monument and Chumphon Ancient Gate and Khorat Fossil Museum; the middle level is seen by 1 tourist attraction such as Phanomwan Castle.
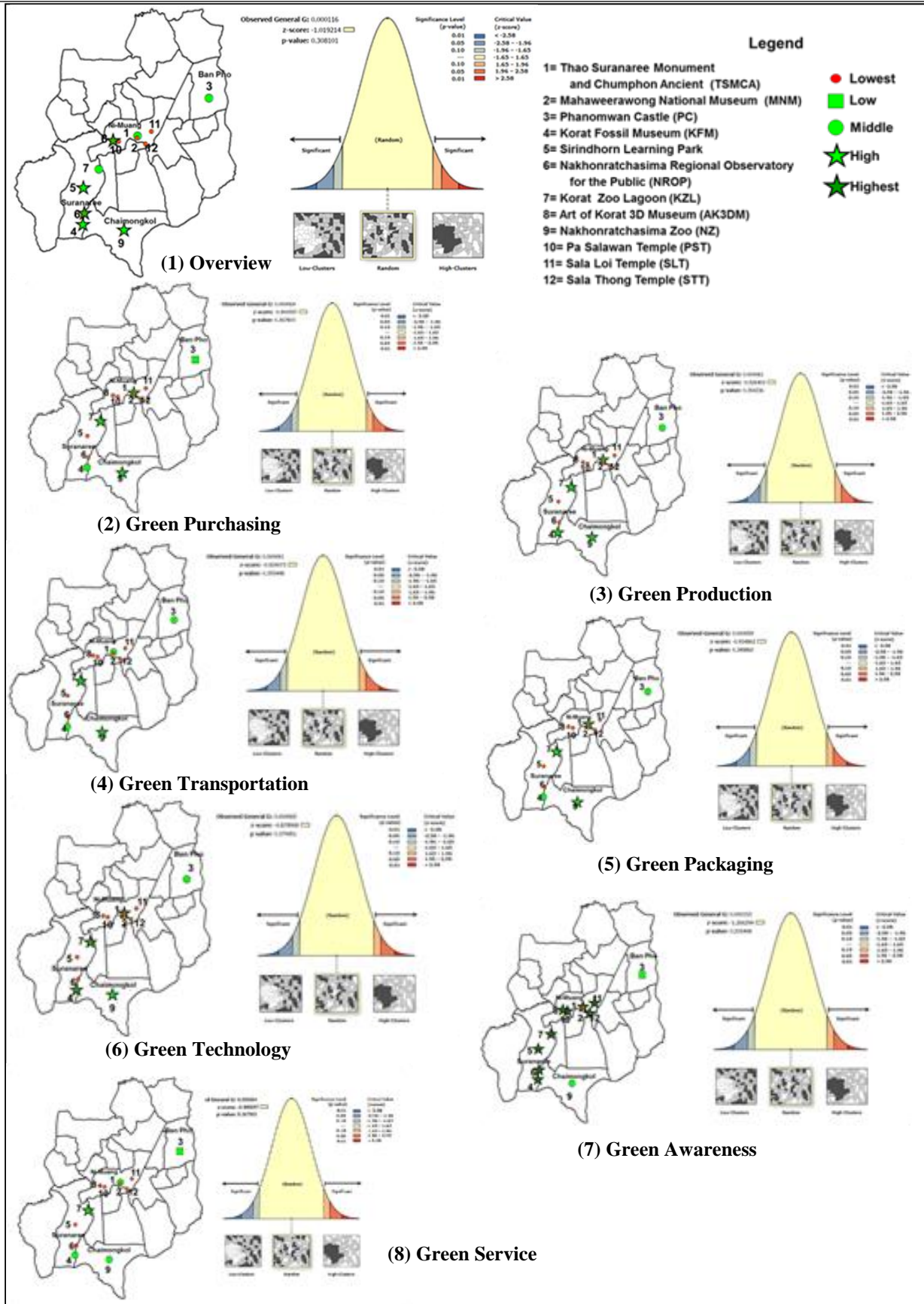
Figure 2. Spatial Distribution Patterns of 8-Green Logistics Activity in 12-tourist attraction in Muang Nakhonratchasima District

3) Green transportation (as shown Figure 2(4)) is spatially analyzed as random distribution pattern with overall average score of 1.40 or lowest level. This activity has a range of scoring and grading from 2.50 (middle) to 3.88 (high). The high level of green transportation is seen by 2 tourist attractions such as Korat Water Park and Nakhonratchasima Zoo; the middle level is seen by 3 tourist attraction such as Thao Suranaree Monument and Chumphon Ancient Gate, Khorat Fossil Museum and Phanomwan Castle.

4) Green packaging (as shown Figure 2(5)) is spatially analyzed as random distribution pattern with overall average score of 1.39 or lowest level. This activity has a range of scoring and grading from 2.50 (middle) to 4.08 (high). The high level of green packaging is seen by 3 tourist attractions such as Nakhonratchasima Zoo, Thao Suranaree Monument and Chumphon Ancient Gate and Korat Water Park; the middle level is seen by 2 tourist attraction such as Khorat Fossil Museum and Phanomwan Castle.

5) Green technology (as shown Figure 2(6)) is spatially analyzed as random distribution pattern with overall average score of 1.76 or low level. This activity has a range of scoring and grading from 2.50 (middle) to 5.00 (highest). The highest level of green technology is seen by 3 tourist attractions such as Khorat Fossil Museum, Thao Suranaree Monument and Chumphon Ancient Gate and Korat Water Park; the middle level is seen by 1 tourist attraction such as Phanomwan Castle.

6) Green awareness (as shown Figure 2(7)) is spatially analyzed as random distribution pattern with overall of average score 4.72 or high level. This activity has a range of scoring and grading from 2.50 (middle) to 5.00 (highest). The highest level of green awareness is seen by 10 tourist attractions such as Thao Suranaree Monument and Chumphon Ancient Gate, Maha Weerawong National Museum, Khorat Fossil Museum, Sirindhorn Learning Park, Nakhonratchasima Regional Observatory for the Public, Korat Water Park, Arts of Korat Mirage Museum, Pa Salawan temple, Sala Loi temple and Sala Thong temple; the high level is seen by 1 tourist attraction such as Nakhonratchasima Zoo; the middle level is seen by 1 tourist attraction such as Phanomwan Castle.

7) Green service (as shown Figure 2(8)) is spatially analyzed as random distribution pattern with overall average score of 2.99 or middle level. This activity has a range of scoring and grading from 2.50 (middle) to 5.00 (highest). The highest level of green service is seen by 3 tourist attractions such as Maha Weerawong National Museum, Nakhonratchasima Regional Observatory for the Public and Arts of Korat Mirage Museum; the high level is seen by 2 tourist attraction such as Khorat Fossil Museum and Sirindhorn Learning; the middle level is seen by 4 tourist attraction such as Thao Suranaree Monument and Chumphon Ancient Gate, Phanomwan Castle, Korat Water Park and Nakhonratchasima Zoo.

5. CONCLUSIONS

Overall score of 8-green logistics activity in 12-tourist attraction in Muang Nakhonratchasima district was calculated and graded, and was found to be in low level with score 1.89. However, green awareness is in high level in almost tourism places except Phanomwan Castle (low level). For the spatial distribution pattern, the results were found to be totally in pattern of complete spatial randomness. This reveals scoring of green logistics activities exist in neither a clustered or dispersed pattern that also refer to as a normative distribution pattern in such 12 tourist attractions of Muang Nakhonratchasima district. This is public and private organization that has realized to reverse logistics, using barcode, electric email, and information online for facing the current COVID-19 situation. Consequently, the obtained results will be suggested for TAT Nakhonratchasima and, office of Nakhonratchasima City Municipality further.

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