

## **ANALYSIS ON SPATIAL DISTRIBUTION OF FIRE STATIONS IN CHANMYATHARZI TOWNSHIP**

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### **Abstracts**

The study aims at analyzing the spatial distribution of fire stations in Chanmyatharzi Township. The objectives are to identify and map all the fire stations in the study area and analyzes their submission with planning standards; determine the distribution pattern of the fire stations. The research is adapted field survey and Global Positioning System (GPS). Arc GIS 10 software was used to draw map of the distribution of the fire stations, and tables, figures were used to present the survey result. The pattern of the distribution is dispersed. The ratio of one fire station to houses is approximately 1:2567. Nearest neighbourhood analysis has shown that the distribution of fire service stations is dispersed in the area. The paper recommended the need to have more and consider population and markets proximity in citing fire service station in the areas as one of the means for achieving better safety situations.

**Keywords:** *Spatial Distribution, fire stations, water source, GIS.*

### **Introduction**

Fire is defined as any –instance of uncontrolled burning, including combustion explosions and fires out an arrival. Providing immediate and effective response to fires is important because emergency is a situation that poses an immediate risk to health, life, poverty or environment. Fire-fighting operations including rescue, fire suppression and property conservation in buildings, enclosed structures, aircraft interiors, vehicle, vessels, or like properties that are involved in an emergency situation (Jackson, 1999).

Excess density of population in city and its slamming- growth has attracted the attention of urban development agents to provide adequate and equitable services to all groups. In United State, in 2006 one person died in a fire accident approximately every 162 minutes on average, and one person was injured every 32 minutes. (Karter and Stein 2008). Each year, fire causes about 300,000 deaths globally and most of these occur in the home (Zhang. Rtal, 2006).

Chanmyatharzi Township experience rapid population growth. In 2018, the total populations are 216,820 persons. The area covers almost 25.56 square kilometer (9.97 sq miles) with a population density of about 21,747 inhabitants per square mile within the study area. From 2012 to 2018 data, mostly burning time has 20 in study area in 2012. In 2017, the second largest of fire was burned 17 times in study area. In 2013, the total of third largest of fire burned was 15 times in study area. The total number of fire was burned 14 times in 2018. In study area, the total number of fire burned has 13 times in 2016 and 8 times in 2015. In 2014, the least number of fires burned was 7 times in study area. In Chanmyatharzi Township, the main occurrences of fire outbreak are due to careless use of electric power, such as in cooking, and air-conditioning etc. The largest fire outbreaks are found in the eastern part of extension wards, which average two times in Chanmyathazi Township.

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## Study Area

Chanmyatharzi Township lies between latitudes 20°43' N and 20°51' N and longitude 96°13' 10' E and 96° 00' 42' E and the altitude 76,20 lm (250 feet) above sea level. It is bounded by Maharaungmyae Township on the north, Pyigyitagun Township and Aamarapura Township on the south, Patheingyi Township on the east and Ayeyarwady River on the west. In 2018, the total population was 216,820 persons, 35,950 houses and 38,604 households in township. The population density was 1 square mile with 21,747 peoples. It is composed of 14 wards and 255 quarters. Therefore the study of fire burning control with spatial distribution of fire stations for Chanmyatharzi Township.

## Aim and Objectives

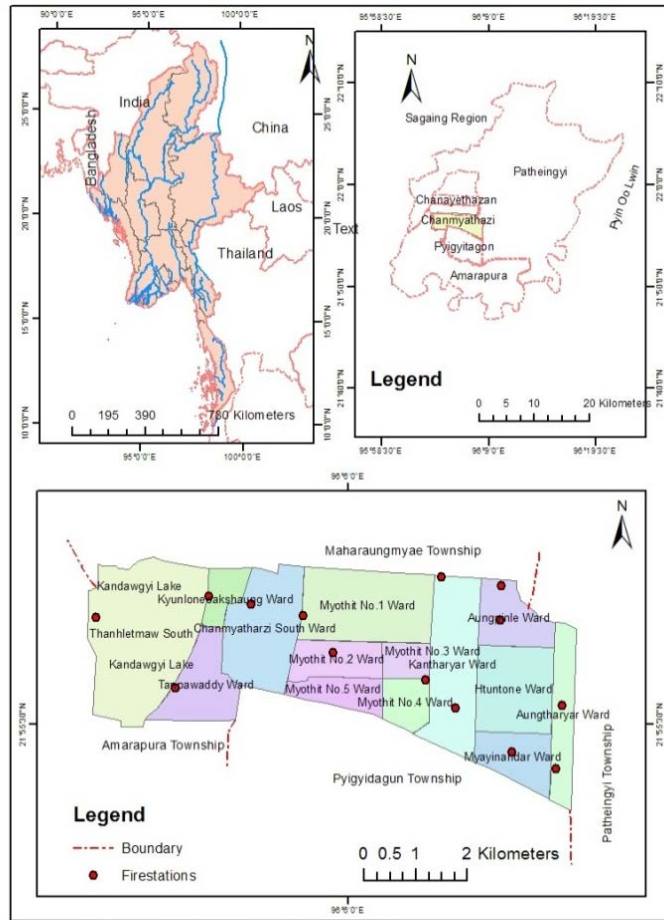
The study aims at analyzing the spatial distribution of fire stations in Chanmyatharzi Township.

The objectives are

- to identify and map all the fire stations in the study area and analysis their submission with planning standards;
- to determine the distribution pattern of the fire stations.

## Materials and Methods

Both primary and secondary data were gathered through pre-field work and detailed field survey. The fire stations and water sources records were collected from the district fire station headquarter this served as a guide to identify the location of all fire stations. Hand held Global Positioning System (GPS) was used to take the Co-ordinate of all fire stations and water sources in study area. A database was created in Microsoft Excel 2007 to record the coordinates, names, locations and facilities. The excel data were saved as dbf and the imported to the Arc Map Environment of Arc GIS 10, for the analysis. Proximity, analysis (Buffering) was used to determine the location of fire stations in the study area with respect to the guidelines of the regulating body. Buffer analysis was performed to determine the served and underserved areas. Nearest Neighbour Analysis was done to determine the pattern of the distribution of fire stations and water sources. This attempts to measure the distributions according to whether they are clustered, random or dispersed. Nearest Neighbour Analysis of the spatial statistics tools was used to determine the pattern distribution using fire stations location, total number of stations and total area covered in kilometer as criteria. Nearest Neighbour Analysis was used to determine the distribution pattern of facilities and has a distribution spectrum that range from random, dispersed to cluster. The nearest fire stations to each the fire stations were determined with the nearest neighbor distance for each of fire station documented. Having determined the area and ascertained the total number of fire stations, the formula below was thus applied in determining the distribution pattern.



Source: Department of Geography, Mandalay University

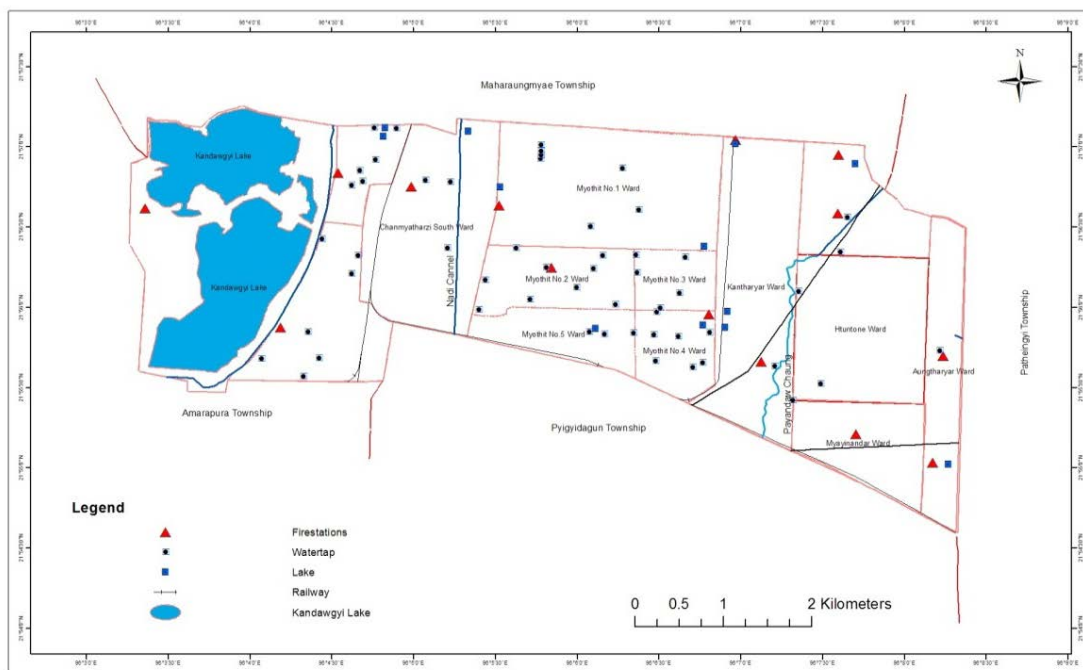
Figure 1 Location Map of Chanmyatharzi Township

$$Rn = \frac{D(Obs)}{0.5 \sqrt{a/n}}$$

Rn is the nearest neighbour value; D (Obs) is the mean observed nearest neighbour distance; a is the area under study; and n is the total number of fire stations. The nearest neighbour formula will produce a result between 0 and 2.15, where the following distribution patterns from a continuum:

### Findings and Discussion

The spatial distributions of fire stations were found fourteen (14) fire stations in Chanmyatharzi Township. The distributions of fire stations are not evenly distributed in Chanmyatharzi Township. Out of which two fire stations are located at Kantharyar ward, Aungpinle ward and Aungharyar ward. Ayeyartun, Tanpawady, Kyunloneoakshaung, Chanmyatharzi south, Myothit No.4, and Myayinandar wards are one station each respectively Figure (2).



Source: Chanmyatharzi Township District Fire Station

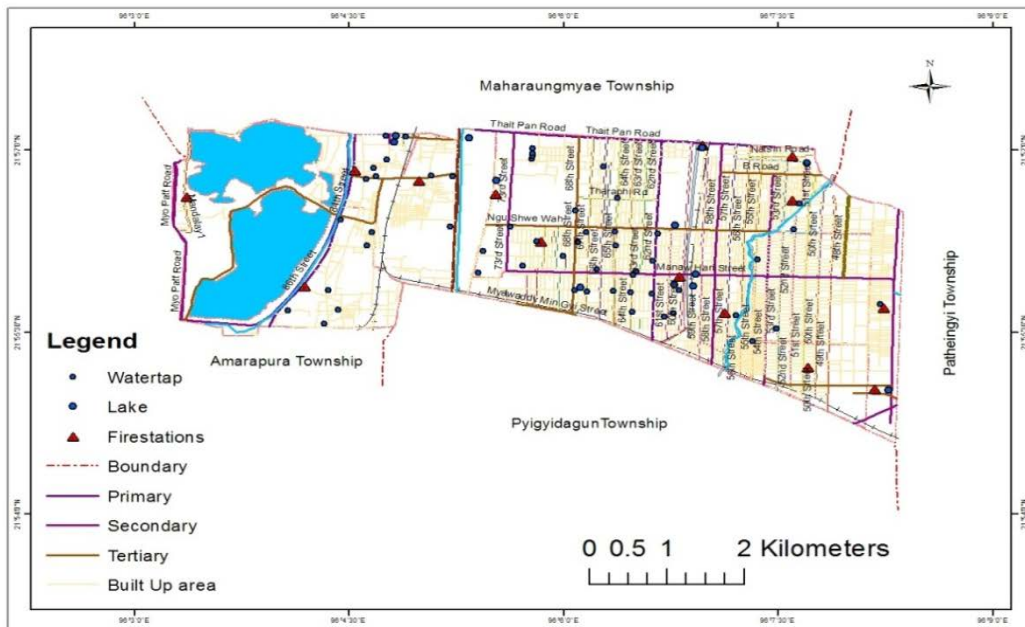
Figure 2 Spatial Distribution of Fire Station in Chanmyatharzi Township

Table (1) and figure (3) the spatial distribution of fire stations based on the roads within the map. The roads are divided into four main categories of map in Chanmyatharzi Township. They are primary road, secondary road, and tertiary road and built up area. The map indicates that there are eight (8) fire stations on the built up area with 57.14 % of largest in study area. The built up area of road are Mandalay Street, Zalatwar road, 57 Street, 50 Street, 45 Street, Bayintnaung road, and Natsin road, Mangalar-Mandalay Street. The second largest of three fire stations are located on primary road with 21.43 %. The primary roads are Thaikpan road, 84 Street and Sagaing-Mandalay road. The third larger of two fire stations are located on the tertiary road and 14.29 %. The tertiary roads are Sagaing branch and 45 Street. The last one fire station is located on secondary road with 7.14 % in study area. The near parts of fire stations are located on primary road which are Tanpawaddy fire station, Kyunloneoakshaung fire station, and District fire station. Chanmyatharzi South and Aungpinle fire stations are located on tertiary road in study area.

Table 1 Fire Station Distribution on the Road in Chanmyatharzi Township

Road	Fire Stations	%
Primary	3	21.43
Secondary	1	7.14
Tertiary	2	14.29
Built up area	8	57.14
<b>Total</b>	<b>14</b>	<b>100</b>

Source: Field Survey



Source: Chanmyatharzi Township District Fire Station

Figure 3 Spatial Distribution of Fire Station on Road in Chanmyatharzi Township

According to figure (4), the Nearest Neighbor Analysis was carried out in respect of the 14 fire stations locating in 25.56 square kilometer (9.97 sq miles) of Chanmyatharzi Township with mean nearest neighborhood distance of 1.41 km. With the Rn value of 2.07, the locational pattern can be said to tend towards dispersed. This is obvious in the high expressed as number of fire stations in residential road corridors of Chanmyatharzi settlement. The present population of 14 fire stations suggests that dispersed.

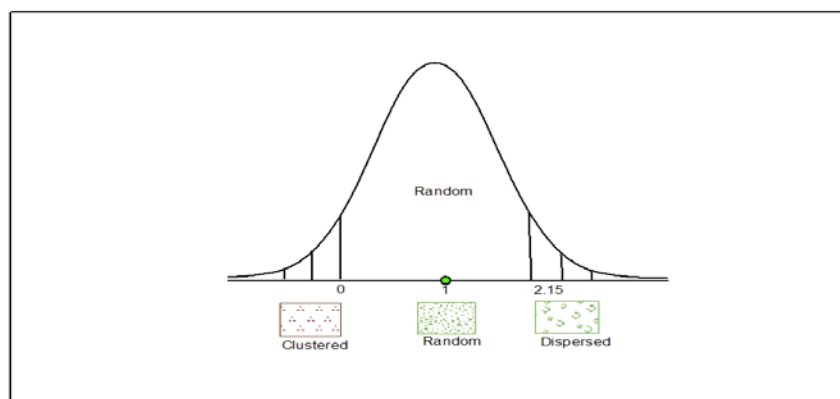


Figure 4 Nearest Neighbor Analysis in Chanmyatharzi Township

### Buffer Analysis of Fire Stations

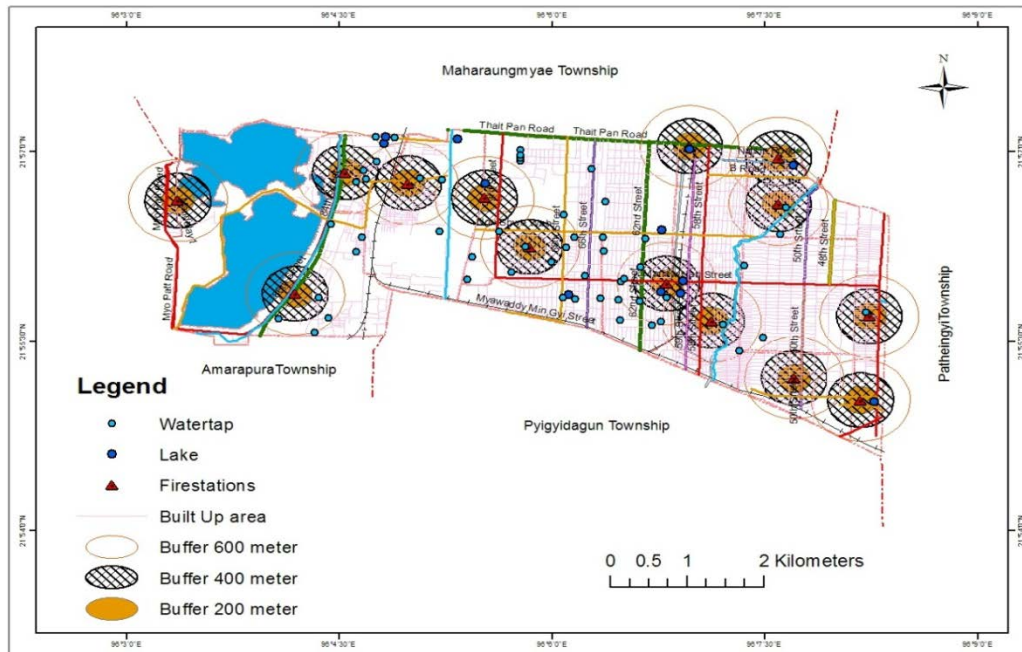
Table 2 and figure 5 show that there is no standard distance for citing fire station in the city. But the distance 200 meter radius was done on the map see analyses the accessibility of water source to fire stations. This shows eleven fire stations. Fire station of Myothit No.4 was only two source of water. The total source of water was 3.03 % in study area. Except Myayinandar, and Tanpawady fire stations and other fire stations are involved with one water source. Ayeyartun fire station connected to Kandawgyi Lake. The distance of 400 meter radius

was done on the map to show that related of 13 fire stations. The largest water source of Myothit No.4 fire station was five source of water and 7.57 %. The second largest of Kyunloneoakshaung fire station was three water sources with 4.54 %. Chanmyatharzi and Myothit No.2 fire stations were two source of water with 3.03 % total source of water. Remaining eight number of fire stations were one water source and 1.5 % of total water source in study area. Myayinandar fire station was not water source within 400 meter. Ayeyartun fire station is connected to Kandawgyi Lake. The distance of 600 meter radius was done on the map to show that related to 12 fire stations. The largest water source of Myothit No.4 fire station was nine sources of water and 13.63 % of total source of water. The second largest of Myothit No.2 was six source of water with 9.09 %. Third largest of Chanmyatharzi South of fire station was five source of water with 1.36 %. Kyunloneoakshaung ward fire station was four water sources with 6.06 %. Tanpawady, Myothit No.1, Aungpinle and Kantharyar ward of fire stations were three water sources with 4.54 %. Kantharyar, Aungpinle, and two stations of Aungtharyar ward of fire stations were one source of water with 1.5 % of total source of water in study area. Myayinandar fire station was not water source within 600 meter in study area. Thus the above explains of three buffer zones far from fire stations are more connected sources of water in Chanmyatharzi Township. Therefore, Myothit No.4 ward of fire station is involved source of water in Chanmyatharzi Township. Finally fourteen fire stations proportion and water sources are found the ratio of (1: 4) one fire station with connection to four source of water in Chanmyatharzi Township.

**Table 2 Spatial Distribution of Fire Stations Buffer in Chanmyatharzi Township**

Buffer 200 meter			Buffer 400 meter			Buffer 600 meter		
Fire Station	Water Source	%	Fire Station	Water Source	%	Fire Station	Water Source	%
1	2	3.03	1	5	7.57	1	9	13.63
11	1	1.5	1	3	4.54	1	6	9.09
2	0	0	2	2	3.03	1	5	7.57
			8	1	1.5	1	4	6.06
			1	0	0	4	3	4.54
						4	1	1.5
						1	0	0

Source: Chanmyatharzi Township District Fire Station

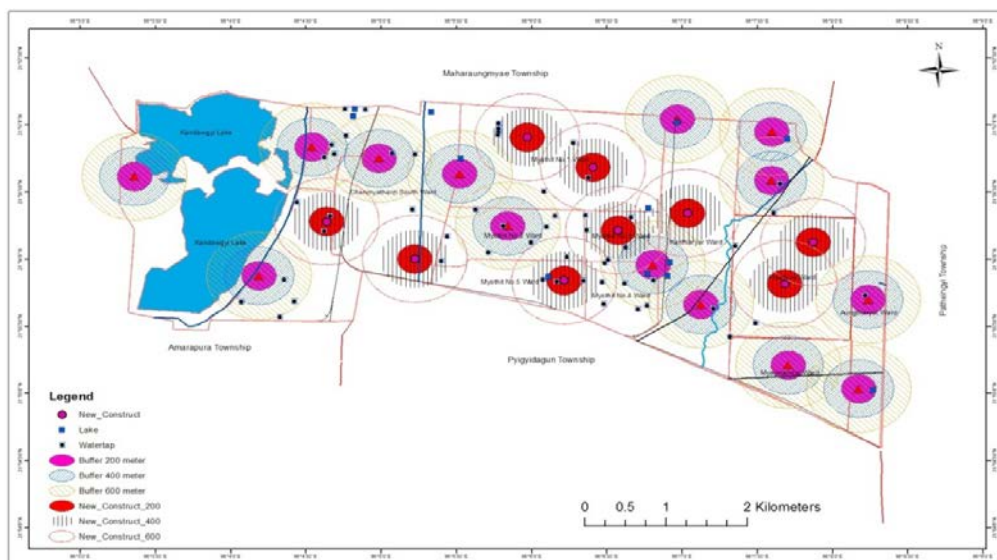


Source: Based on Field Survey

Figure 5 Spatial Distribution of Fire Stations Buffer in Chanmyatharzi Township

### Conclusion and Recommendation

The use of GIS technology was proven powerful to the achievement of the fire stations in the study area. The study shows that the distribution of fire station is dispersed with respect to the regulating bodies' guidelines. This study examined the spatial distribution of fire stations in Chanmyatharzi Township. The study revealed that there are eight (8) fire stations on the built up area around the settlement. An analysis of the fire vulnerability map shows that these fire stations are not evenly distributed among the township. Furthermore, these fire stations are grossly inadequate to serve the ever expanding Chanmyatharzi Township with its rapidly growing population. Analysis of the fire vulnerability map revealed that Htundone, Kantharyar, Myothit No.1, No.3 and No.5 wards are poorly covered, hence most vulnerable to fire hazard, while Thanlyetmaw South, Tanpawady, Kyunloneoakshaung, Chanmyatharzi South, Myothit No.2, Myothit No.4, Myayinandar, Aungpinle and Aungtharyar wards are the coverage, thus the least vulnerable to fire hazard. For assessing the locational appropriateness of fire stations are critically considered, none of the fire stations in the study area is worthy of town planning approval. These are Myothit No.3, Myothit No.5, and Htundone wards. These wards are new constructed of fire stations in the study area. At least 2 additional fire stations each should be sited in Htundone, Kantharyar, Myothit No.1, No.3 and No.5 an additional fire station in the township. Moreover, according GIS software of buffer method, the distance of radius 200 meter is sparsely water sources. Therefore, new water resources are constructed by planning authority in the study area. In light of the above the following are recommended: Fire Service should adopt a scientific approach such as the use of location- allocation models in determining the appropriate location for fire stations within the township. However, it recommends the need for buffer of approval carried out in respect of fire stations in the study area new fire stations constructed planning in figure (6). Tanpawady, Chanmyatharzi South, Myothit No.1, Myothit No.2, Myothit No.4, Kantharyar, and Htundone Wards are respectively.



Source: Based on Field Survey

Figure 6 New Construction of Fire Stations in Chanmyatharzi Township

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