In [1]:
```
#Adding various required libraries
from ast import increment_lineno
import pandas as pd
from sklearn.cluster import KMeans
import folium
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [2]:
```
#Code for reading the csv file containing the data
df = pd.read_csv("Kerala Blackspots with nearest hospitals finalised dataset (csv) (2).csv")
df.head()
```

Out[2]:

	Sl. No.	Name of District	Name of Police Station	Name of Landmark	Name of Location	Lattitude	Longitude	Name of Road	HOSPITAL NEAR LATITUDE	HOSPITAL NEAR LONGITUDE	Accident Severity Index	Type of Road	Number of Fatalities	Sum of Fatal & Grievous Injury Crashes
0	1	Thiruvananthapuram	Karamana	Pappanamcode Mosque - Kerala Gramin Bank	Pappanamcode Junction	8.470460	76.980803	National Highway 66 (NH 66)	8.724141	77.028555	366	NH	15	102
1	2	Kollam	Chavara PS	Regent Lake Palace - 110m before Hindustan Pet...	Parimanam Temple	8.954698	76.534274	National Highway 66 (NH 66)	8.955805	76.534519	357	NH	17	99
2	3	Thiruvananthapuram	CITY TRAFFIC	Tax Towers - Karamana Junction	Karamana Junction	8.482015	76.967072	National Highway 66 (NH 66)	8.481656	76.963152	314	NH	8	94
3	4	Malappuram	KUTTIPURAM	Vyapara Bhavan - 200m after Highway Junction	Kuttipuram Highway Junction	10.842810	76.030021	National Highway 66 (NH 66)	10.854681	76.037121	306	NH	12	86
4	5	Thiruvananthapuram	Balaramapuram	Kodinada Junction - Indian Oil Petrol Pump	Balaramapuram Junction	8.430501	77.046417	National Highway 66 (NH 66)	8.426988	77.043805	300	NH	6	92

In [3]:
```
#Assigning columns "Accident Severity Index","Number of Fatalities", "Sum of Fatal & Grievous Injury Crashes" to a variable 'z'
z = df[["Accident Severity Index","Number of Fatalities", "Sum of Fatal & Grievous Injury Crashes"]]

#Printing z
z.head()
```

Out[3]:

	Accident Severity Index	Number of Fatalities	Sum of Fatal & Grievous Injury Crashes
0	366	15	102
1	357	17	99
2	314	8	94
3	306	12	86
4	300	6	92

Below 3 lines of code is for finding the optimum number of clusters using Elbow method.

In [5]:
```
wcss = []
for i in range(1,11):
    model = KMeans(n_clusters=i)
    y_kmeans = model.fit_predict(z)
    wcss.append(model.inertia_)
```

```
C:\Users\abita\anaconda3\envs\Intel_code\lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set th
e value of `n_init` explicitly to suppress the warning
  warnings.warn(
C:\Users\abita\anaconda3\envs\Intel_code\lib\site-packages\sklearn\cluster\_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are l
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  warnings.warn(
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ess chunks than available threads. You can avoid it by setting the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```
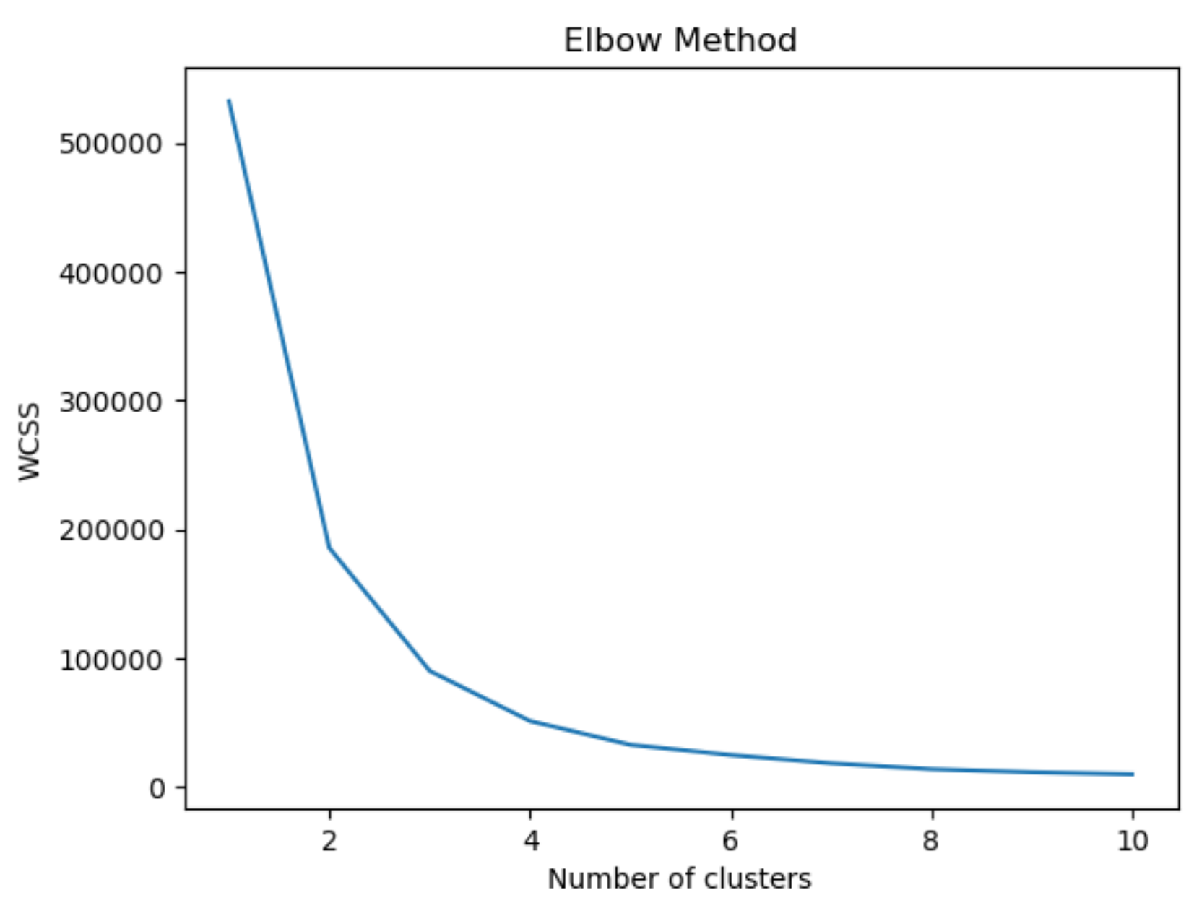

In [6]:
```
model.inertia_
```

Out[6]:
```
9796.47560565871
```

In [7]:
```
#Plotting it into the Elbow graph
plt.plot(range(1, 11), wcss)
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.title('Elbow Method')
plt.show()
```



Therefore the optimum number of clusters is 3 from the Elbow graph

In [9]:
```
#Clustering the data into 3 clusters
model = KMeans(n_clusters=3)
y_kmeans = model.fit_predict(z)
```

```
C:\Users\abita\anaconda3\envs\Intel_code\lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The default value of `n_init` will change from 10 to 'auto' in 1.4. Set th
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  warnings.warn(
C:\Users\abita\anaconda3\envs\Intel_code\lib\site-packages\sklearn\cluster\_kmeans.py:1382: UserWarning: KMeans is known to have a memory leak on Windows with MKL, when there are l
ess chunks than available threads. You can avoid it by setting the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```

In [10]:
```
df['y'] = y_kmeans
```

In [11]:
```
#Downloading the data to be clustered
df.to_csv("final_data_with_cluster.csv")
```

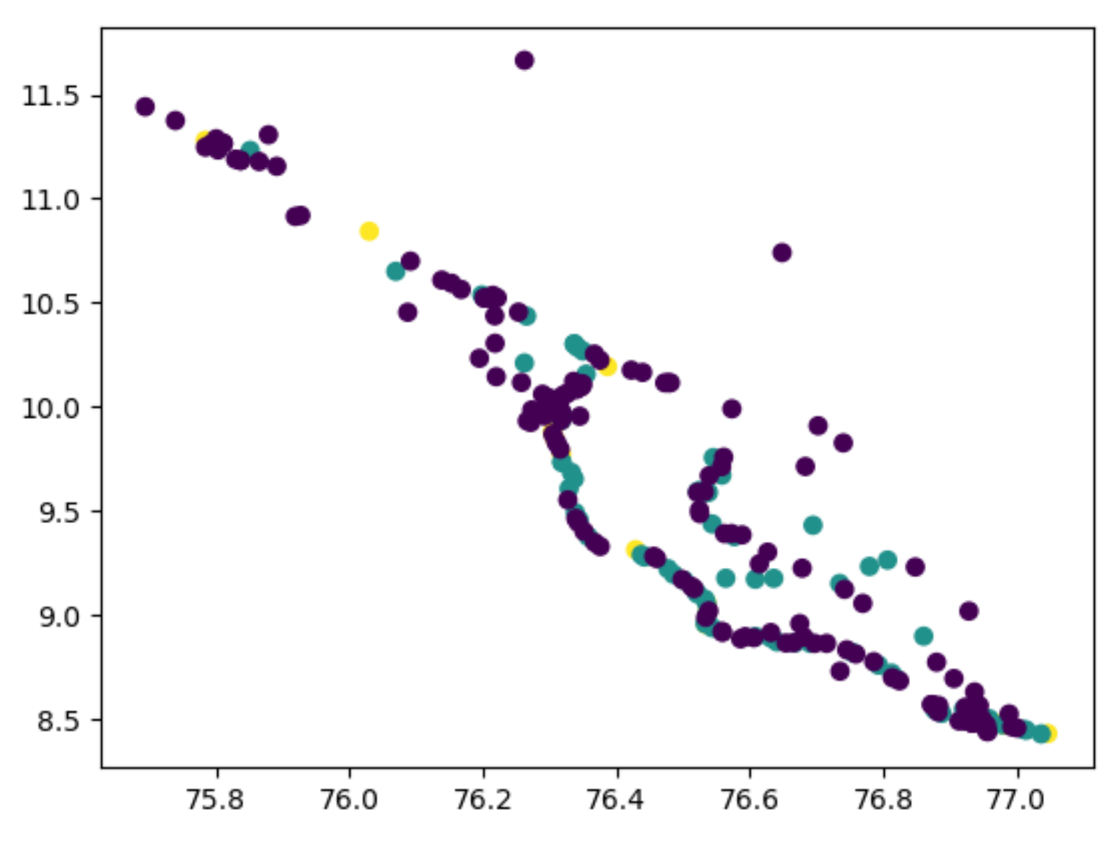
In [12]:
```
#Printing data to be mapped with k means variable 'y'
df.head()
```

Out[12]:

	Sl. No.	Name of District	Name of Police Station	Name of Landmark	Name of Location	Lattitude	Longitude	Name of Road	HOSPITAL NEAR LATITUDE	HOSPITAL NEAR LONGITUDE	Accident Severity Index	Type of Road	Number of Fatalities	Sum of Fatal & Grievous Injury Crashes	y
0	1	Thiruvananthapuram	Karamana	Pappanamcode Mosque - Kerala Gramin Bank	Pappanamcode Junction	8.470460	76.980803	National Highway 66 (NH 66)	8.724141	77.028555	366	NH	15	102	2
1	2	Kollam	Chavara PS	Regent Lake Palace - 110m before Hindustan Pet...	Parimanam Temple	8.954698	76.534274	National Highway 66 (NH 66)	8.955805	76.534519	357	NH	17	99	2
2	3	Thiruvananthapuram	CITY TRAFFIC	Tax Towers - Karamana Junction	Karamana Junction	8.482015	76.967072	National Highway 66 (NH 66)	8.481656	76.963152	314	NH	8	94	2
3	4	Malappuram	KUTTIPURAM	Vyapara Bhavan - 200m after Highway Junction	Kuttipuram Highway Junction	10.842810	76.030021	National Highway 66 (NH 66)	10.854681	76.037121	306	NH	12	86	2
4	5	Thiruvananthapuram	Balaramapuram	Kodinada Junction - Indian Oil Petrol Pump	Balaramapuram Junction	8.430501	77.046417	National Highway 66 (NH 66)	8.426988	77.043805	300	NH	6	92	2

In [13]:
```
#Creating clusters
plt.scatter(df['Longitude'], df['Lattitude'],c=df['y'],)
```

Out[13]:
```
<matplotlib.collections.PathCollection at 0x1c39bf4ee30>
```



below 3 lines are for categorising and grouping the locations based on (low,moderate and high)

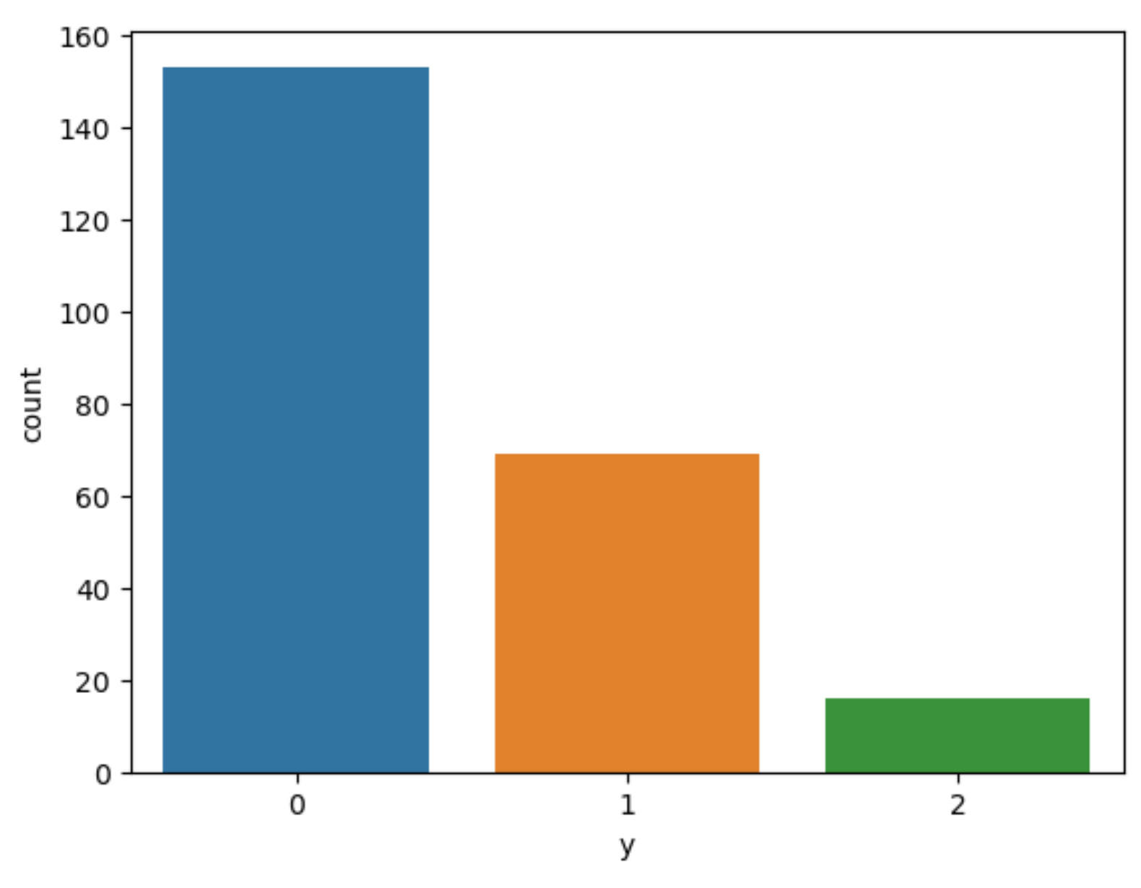
In [15]:
```
import seaborn as sns
import matplotlib.pyplot as plt
```

In [16]:
```
df['y'] = pd.Categorical(df.y)
df.y.value_counts()
```

Out[16]:
```
0    153
1     69
2     16
Name: y, dtype: int64
```

In [17]:
```
sns.countplot(x ='y', data = df)
```

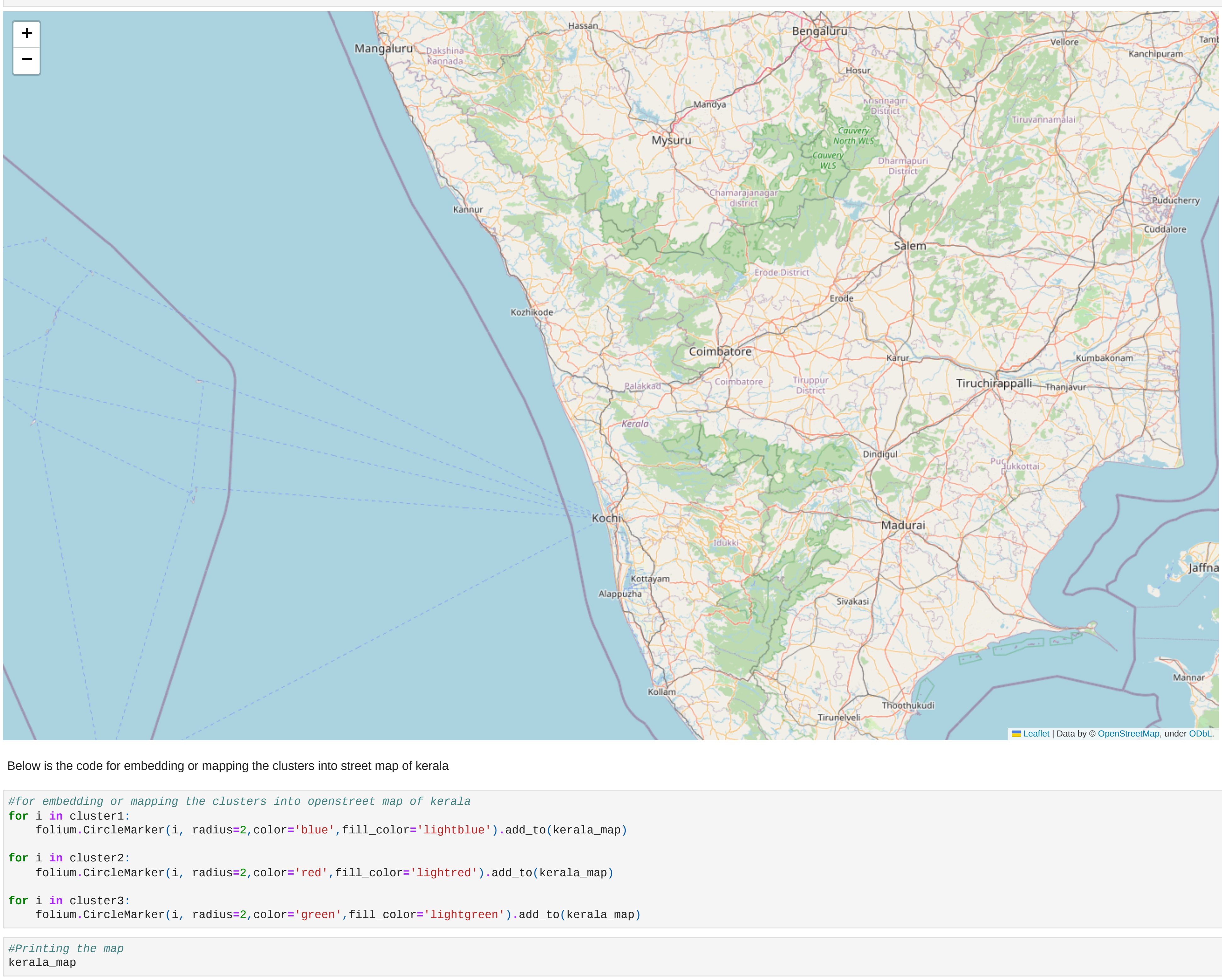
Out[17]:
```
<AxesSubplot:xlabel='y', ylabel='count'>
```



In [18]:
```
#Below codes are for deviding the clusters into 3 groups (cluster1,cluster2 and cluster3)
cluster1 = df[['Lattitude', "Longitude"]][df['y'] == 0].values.tolist()
cluster2 = df[['Lattitude', "Longitude"]][df['y'] == 1].values.tolist()
cluster3 = df[['Lattitude', "Longitude"]][df['y'] == 2].values.tolist()
```

In [19]:
```
#Printing the Kerala state openstreet map
kerala_map = folium.Map(location=[10.8505, 76.2711], zoom_start=8,tiles = "openstreetmap")
kerala_map
```

Out[19]:



Below is the code for embedding or mapping the clusters into street map of kerala

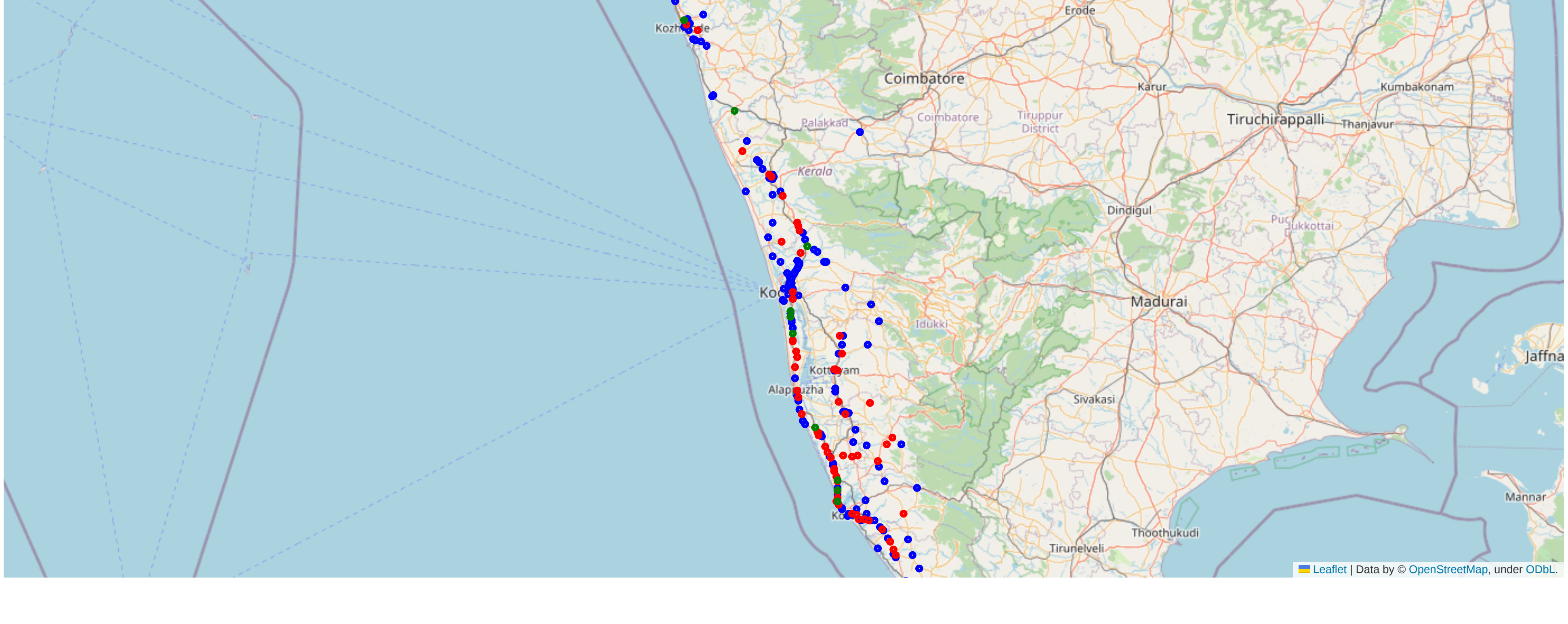
In [21]:
```
#for embedding or mapping the clusters into openstreet map of kerala
for i in cluster1:
    folium.CircleMarker(i, radius=2,color='blue',fill_color='lightblue').add_to(kerala_map)

for i in cluster2:
    folium.CircleMarker(i, radius=2,color='red',fill_color='lightred').add_to(kerala_map)

for i in cluster3:
    folium.CircleMarker(i, radius=2,color='green',fill_color='lightgreen').add_to(kerala_map)
```

In [22]:
```
#Printing the map
kerala_map
```

Out[22]:


+
−
Mangaluru
Hassan
Bengaluru
Mysuru
Kannur
Kozhikode
Salem
Coimbatore
Palakkad
Kerala
Tiruchirappalli
Madurai
Leaflet | Data by © OpenStreetMap, under ODbL.