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Identification of Appropriate Locations for Various Water Supply and Sanitation Infrastructure in Chiplun using Q-GIS

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***Abstract*: QGIS is one of the best software for site selection. With the help of QGIS software we can select sites without doing the physical survey of the region for which we are going to do site selection.**

There should be the proper or appropriate sites for water treatment plant, sewage treatment plant and Landfill. The proper or appropriate site means the site should be at proper distance from different areas like agricultural area, residential area, forest area, road, railway line, etc. according to the government norms, For this we can QGIS software. If we do the site selection by actually going on site, then it will be time consuming but this disadvantage can be overcome with the help of QGIS. In this study we have done site selection for landfill, WTP, STP by using QGIS software. First, we have identified the study area for which we are going to select the WTP, STP and landfill sites. Then we have prepared LULC map. We have identified different regions of land like agricultural, forest, river, etc. and prepared LULC map also we have located road network and railway line.

After preparing LULC we have found the buffer distances to locate buffer zones for WTP, STP, Landfill. Buffer zone means the area which separates the two lands from each other. In our case buffer zone separates WTP, STP, Landfill from agricultural, residential, forest, etc. After that we have applied buffer distances for each area. After application of buffer the which remained in which we have located the sites for WTP, STP and landfill.

INTRODUCTION:

The proper disposal and management of wastes (Liquid waste and solid waste) generated in the city is one of the critical issues. The management of waste has major impact on ecology and environmental health. Due to rapid urbanization and increasing growth of population solid waste management has become acute in India. There are different water supply and sanitary infrastructures for the management and disposal of waste. Landfilling is one of the best solutions for solid waste disposal. If the region contains the different industries, then liquid waste is one of the greatest issues along with the solid waste and hence there should be facilities for the disposal of these generated wastes. Sewage generated from industries should undergoes proper treatment in the sewage treatment plant. With the help of these infrastructures, we can control waste management efficiently, but for this these infrastructures should be located on proper site.

Population growth, rapid urbanization and booming economy and also the increase in living standards of each community the rate of municipal solid waste generation is increasing nowdays in every country. Usually, the municipality has the responsibility for the management of the waste generated within the cities, municipality facing the challenges associated with the economy, space and providing effective system for the inhabitants. The elementary goal for the solid waste management system is to handle the land use, economic consideration, health and environmental aspects connected with inappropriate disposal of waste. In many countries due to the poor management of waste disposal creates severe environmental issues that have an effect on the welfare of humans and animals and produce cocering serious economic and welfare losses.

Site selection is becoming very challenging task involving socio-economical, environmental and technical dimension. Because while selecting the site we have to take care all the environmental, ecological and social factors. The treatment of sewage is large scale process so it should be done at proper site. While treating sewage so many harmful substances or gases are generated. If the site is very close to the residential, agricultural, water bodies or near to any environmentally sensitive area then there will be enormous harmful impact. So, to avoid this we have to select the appropriate sites for the sewage treatment plant which satisfying all the site selection criteria. With the help of Quantum Geographic Information System (Q-GIS) we can achieve this goal very easily.

STUDY AREA:

CHIPLUN is a city and a tehsil in Ratnagiri district in the state of Maharashtra, India. It is the head-quarter of Chiplun taluka and located on the Mumbai–Goa highway (NH-66) (it was earlier numbered as NH-17) in western India. The city is about 320 km south of Mumbai in the Konkan region of Maharashtra. It is a fast-developing city in Konkan with a strong cultural background. The name Chiplun means "The abode of Lord Parshuram".

Chiplun city is the economical and commercial Centre of the Ratnagiri District. It is connected to the National Highway 66 and the State Highway 78. It is well connected to Mumbai, Pune, Panaji, etc.

Chiplun municipal council is the head quarter of taluka Chiplun in Ratnagiri district of Maharashtra state situated on a west coast of India. This is hilly region and it also lies in between the valley which is covered by Western

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Ghats on one side and the Arabian Sea on the other side. The work area of Chiplun region is 24.73 Sq. Kms. The industries are growing on large scale. There are 3 MIDC developed Sat a distance of 12 to 15 Kms from Chiplun.

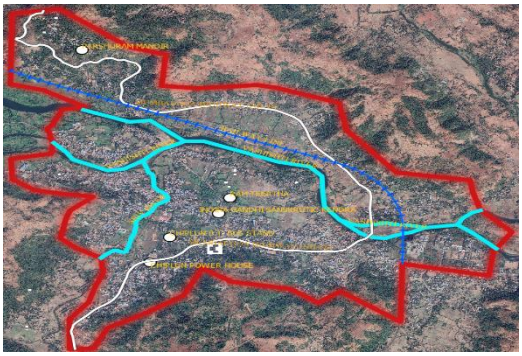


Fig.01: Study Area (Chiplun)

Material: A geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. GIS can show many different kinds of data on one map. This enables people to more easily see, analyse, and understand patterns and relationships. With GIS technology; people can compare the locations of different things in order to discover how they relate to each other. It can include information about the land, such as the location of streams, different kinds of vegetation, and different kinds of soil. It can include information about the sites of factories, farms, and schools, or storm drains, roads and electric power lines.

In this study we have used version 3.16 of Q GIS software. We have used this version because this version is user friendly. It is very easy to use.

METHODOLOGY:

1) Identification of different planning parameter: Based on literature study, considering Geophysical conditions, and available data on the study area, following criteria were adopted to select suitable site for landfill, WTP & STP.The importance of those criteria and the basis of their selection are outlined below:

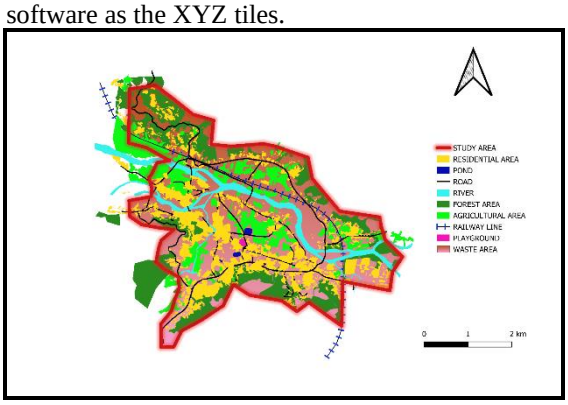
Sr N	Landfill	WTP	STP
1	Elevation	Elevation	Elevation
2	Availability of waste land	Source of water bodies	Away from Residential area
3	Distance from Road, Residential area, water bodies, Agricultural area	Distance from Road, Residential area, water bodies, Agricultural area	Distance from Road, water bodies, Agricultural area
4	Existing dumping ground	Present & Future land use	Present & Future land use
5	Ground water depth	Topography of the area	Ground water depth

Table no 01: Different planning parameter for Landfill, WTP, STP

2) Analysis of different routes: Transportation is one of the major factors which affect the economy of the solid waste management. Transportation of the sludge generated in the STP, WTP required cost and this cost can be reduced by optimizing the best route. It is possible that there may be the multiple routes for transportation of waste. From these routes to identify the best appropriate route we will required to do the analysis of the road network in the study area.

3) Preparation of different types of maps (LULC, Contour map):

Land use-Land cover is all about differentiating a given land into various entities such as residential area, agricultural land, water bodies, waste area etc. For the particular area, a land use land cover analysis has to be done to analyse land use and land coverage areas so that we can identify the vacant sites in the given study area. Vacant sites mean the the area of the land which not comes under the any category like agricultural, residential or forest area etc. Basically, identification is very important because in the vacant sites we are going to locate the sites for the landfill, WTP and STP. In this paper the major classification used for the land is residential area, agricultural land, water bodies, forest area. To do so, the google map is opened in the QGIS software as the XYZ tiles.



Map 01: Land use Land cover map

4) Buffering & Analysis: Buffering usually creates two areas: one area that is within a specified distance to selected real world features and the other area that is beyond. The area that is within the specified distance is called the buffer zone.

According to the Schedule-I of (Solid Waste Management Rules, Ministry of Environment, India 2016) , **(T. Subramani, et al. (2014)), (Kerala Water Authority, (2021)** following are the buffer distances for Landfill, WTP, STP with respect to different areas mentioned in table 02.

AREA	BUFFER DISTANCES IN METERS		
	LANDFILL	WTP	STP
Residential	500	200	400
Road	100	60	200
River	100	100	200
Pond	200	200	200
Agricultural	200	300	200
Playground	200	200	400
Forest	200	100	100
Railway	200	100	200

Table 02: Buffer Distances for LANDFILL, STP, WTP

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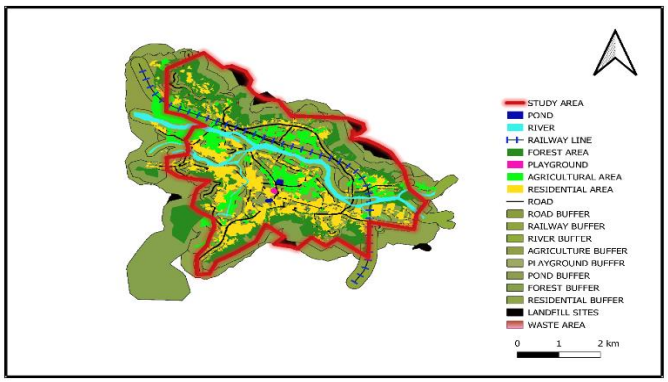
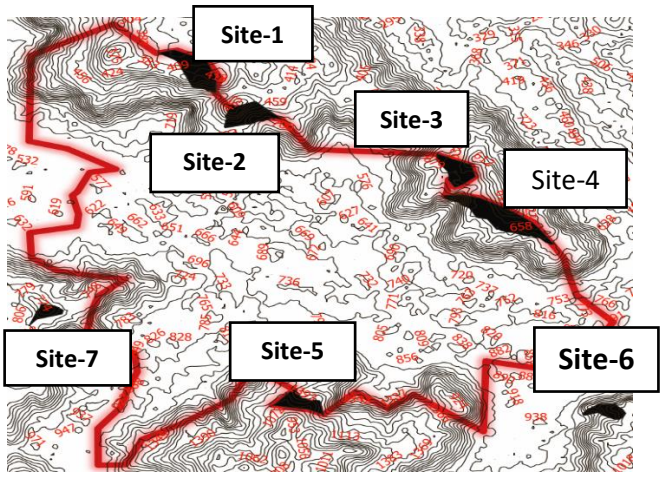
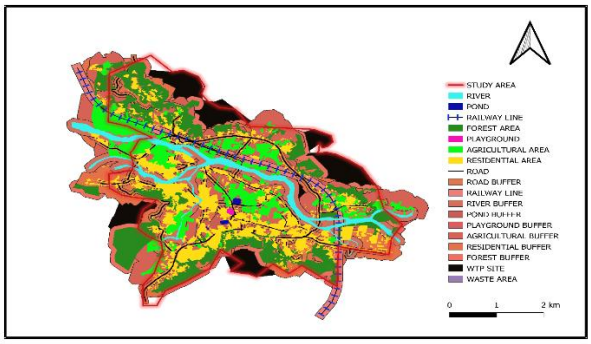
A) Landfill Buffering: 7 sites located after buffering.

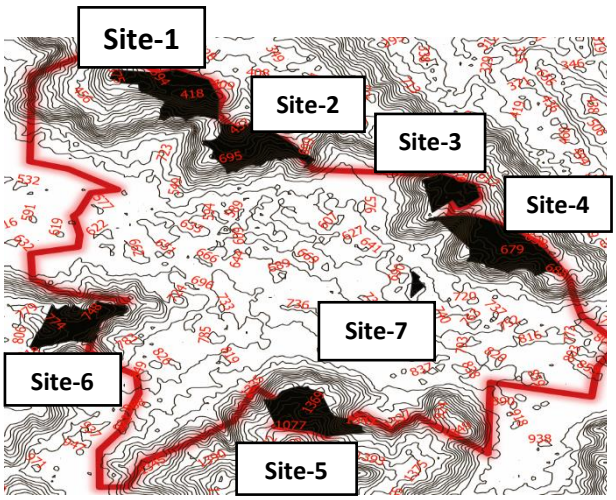




Map 02: Landfill Buffered Map with Optimal Sites

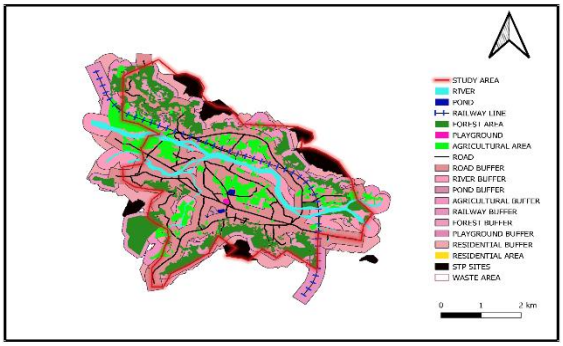
B) WTP buffering: 7 sites were located after buffering.

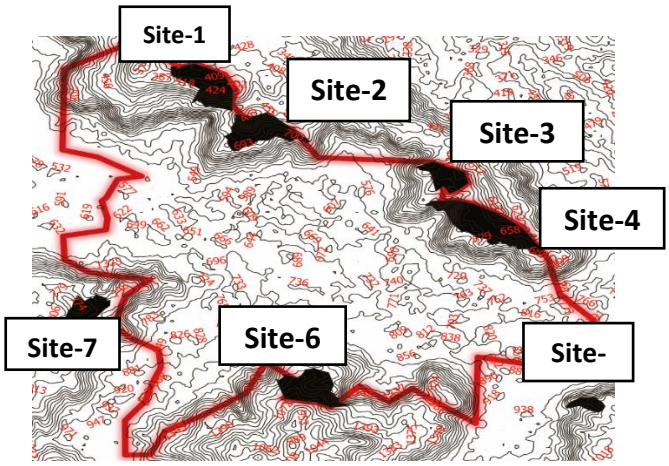




Map 03: WTP Buffered Map with Optimal Sites

C) STP Buffering: 7 sites located after buffering.





Map 04: STP Buffered Map with Optimal Sites

A) For Landfill:

Sites No	Area (Km^2)	Elevation (m)	Topography	Accessibility Of Route	Conclusion	Remark
1	0.166	423	Gentle slope	Not Easily accessible	Nearest to the out sided residential area	Rejected
2	0.134	539	Sloping ground towards NW	Easily accessible	Steep sloping ground	Rejected
3	0.103	640.5	Moderate slope	Easily accessible	Less area	Rejected
4	0.248	628	Gentle slope	Easily accessible	Most suitable	Adopted
5	0.064	1349	Highly elevated	Not Easily accessible	Outside of study area	Rejected
6	0.083	1248	Steep slope	Easily accessible	Existing Dumping site	Rejected
7	0.046	774	Gentle slope	Not Easily accessible	Outside of study area	Rejected

Table no 03: Discussion of result for Landfill sites

For landfill there were total 7 sites located. From these sites one site of area about 0.248 Sq. km. is adopted.

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B) For WTP:

Site No	Area (km^2)	Elevation (m)	Availability of water source	Conclusion	Remark
1	0.493	423	Railway line between water source & railway line, road	Not easy to access water	Rejected
2	0.470	539	Railway line between water source & railway line, road	Not easy to access water	Rejected
3	0.208	640.5	Railway line between water source & railway line, road	Not easy to access water	Rejected
4	0.594	628	Railway line between water source & railway line, road	Already adopted for landfill site	Rejected
5	0.432	1248	Water source available at greater distance	Existing dumping ground	Rejected
6	0.373	774	Near river	Outside of study area	Can be adopted but located outside of the study area
7	0.284	703	Very close to water source	Most suitable	Adopted for WTP

Table no 04: Discussion of result for WTP sites

For Water Treatment Plant 2 sites were adopted from 7 optimal sites. Out of these 2 sites one site is adoptable only after the relocation of people.

C) For STP:

Site No	Area (Km^2)	Elevation (m)	Proximity to residential area	Conclusion	Remark
1	0.297	425	Near to the residential area	Very close to residential area	Can be adopted but relocation of people required
2	0.301	540	Near to the residential area	Very close to residential area	Can be adopted but relocation of people required
3	0.151	640	Away from residential area	Suitable	Adopted
4	0.458	630	Away from residential area	Adopted for landfill	Rejected
5	0.061	1350	Away from residential area	Highly elevated	Rejected
6	0.284	1250	Near to the residential area	Existing dumping ground	Rejected
7	0.150	775	Near to the residential area	Highly elevated	Rejected

Table no 05: Discussion of result for STP sites

For Sewage Treatment Plant 2 sites are adoptable but only after the relocation of peoples. 3rd site is most suitable.

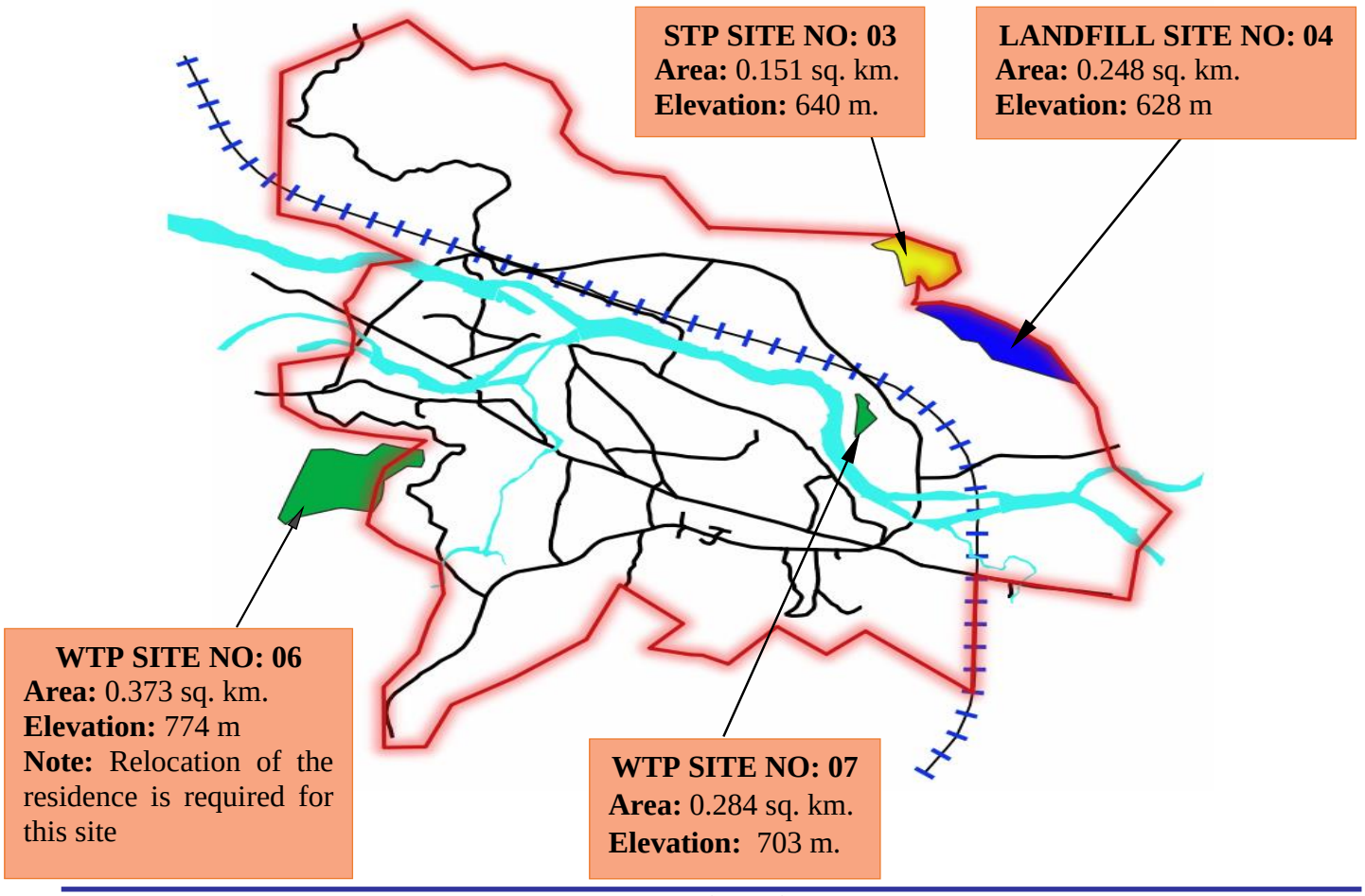

Fig 02: Final sites for Landfill, WTP, STP

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CONCLUSION:

It was discussed in the previous chapter about various sites obtain by using sites suitability analysis. Analysing all the sites with respect to different criteria, we have concluded that one most suitable site for each (landfill, WTP, STP).

A) Most suitable site for landfill: Site no 04: This site has been selected as the most suitable site, as it has maximum area being far away from residential area, water bodies & other agricultural area. This site is easily accessible from road network, so transportation of waste is easy & economically.

B) Most suitable site for WTP:

Site no – 07: This site has been given first priority as it has major area is near from water sources (Vashisthi River), So it has easily accessible water from source. This site is situated at high elevation (703 m)

Site no – 06: This site has also more area which near from water source & elevation (774) So it has been given 2nd priority. But actually, it is outside from our study area.

C) Most suitable site for STP:

Site no.- 03: This site is selected among of 7 sites because this site is near to road, low elevation (640 m), away from residential area.

RESULT:

For the given study area minimum one site for the landfill, water treatment plant and sewage treatment plant is located with the help of the QGIS.

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