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Assessment of land suitability potentials for future development – A case study of Bharuch - Ankleshwar twin cities through GIS

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Abstract: Bharuch and Ankleshwar are called as twin cities in Gujarat. These cities are industrial based economic generating urban areas along Delhi – Mumbai Industrial Corridor. Bharuch – Ankleshwar urban Development Authority had made development plan for these twin cities for 2032. This research papers studies the potentials of land for development plan through GIS based approach. Assessment of Land suitability potentials is an essential advance to recognise the feasible land use in urban planning. Land suitability was done for the Bharuch and Ankleshwar municipal boundaries including the neighbouring villages which are sharing the boundary with the municipalities. Land suitability was conducted by taking different parameters based on the characteristics of these cities and available data, viz. city boundaries, proximity to national highways, proximity to state highways, proximity to village roads, river, slope and water bodes.

Keywords: GIS approach, development plan, land suitability potentials.

I. INTRODUCTION

The better land use alternatives could be executed in various land units as the ordinary land assessment strategies experience the ill effects of constraint spatial investigation for land suitability. This paper goes around two major word land and suitability. Land is a topographical location product comprises with soil, climate, hydrology and vegetation to the extent that these influence potentials of land use. Land use in any area is influenced by the economical, physical, social characteristics and many more factors according to the place but in this paper land suitability potentials are assessed by considering only physical parameter, viz. two city boundaries, proximity to national highways, proximity to state highways, proximity to village roads, river, slope and water bodes. Land suitability evaluation provides information on the constraints and opportunities for the use of land and therefore guides decisions on optimal utilisation of resources, those knowledge in an essential prerequisite for land use planning and development. (BANDYOPADHYAY, JAISWAL, HEGDE, & JAYARAMAN, 2009).

II. CASE AREA PROFILE

Bharuch and Ankleshwar lies in the western parts of Gujarat promontory. The topology is relatively plain and the fluctuates as we move far from the Narmada river. The geology formation of the territory is due to the residue stored by river Narmada. Profundity of ground water level in this locale is above 10m from the main sea level. The main soil type in the region is alluvial soil. The safeguard soil of this area is exceptionally ripe. The maximum and minimum temperatures were recorded 45^{o}c and 14^{o}c respectively. May is the most blazing month with high mean daily maximum temperature. January is the coldest month with mean daily minimum temperature. The precipitation in the area is received mainly during the southwest season from June to September. The average annual precipitation of the area is around 788mm.

Bharuch is the oldest city in Gujarat formerly called as broach and also second oldest city of India having continuous initiations, first being Banaras (Varanasi). Bharuch has as known history for about 8000 years. The city of Bharuch and its surrounds has been settled far back into antiquity and was a major shipping building center and sea port in important pre-compass coastal trading routes to points West, perhaps as far back as the days of the Pharaohs, which utilized the regular and predictable Monsoon winds or galleys.

Bharuch and Ankleshwar cities are enriched with industrial establishments like GIDC, GNFC. There are more green fields projects either implemented or under pipeline and are going to be most important factor for economic development as well as planning process of the region.This region had biggest liquid cargo terminal in Gujarat and also called as chemical capital of India.

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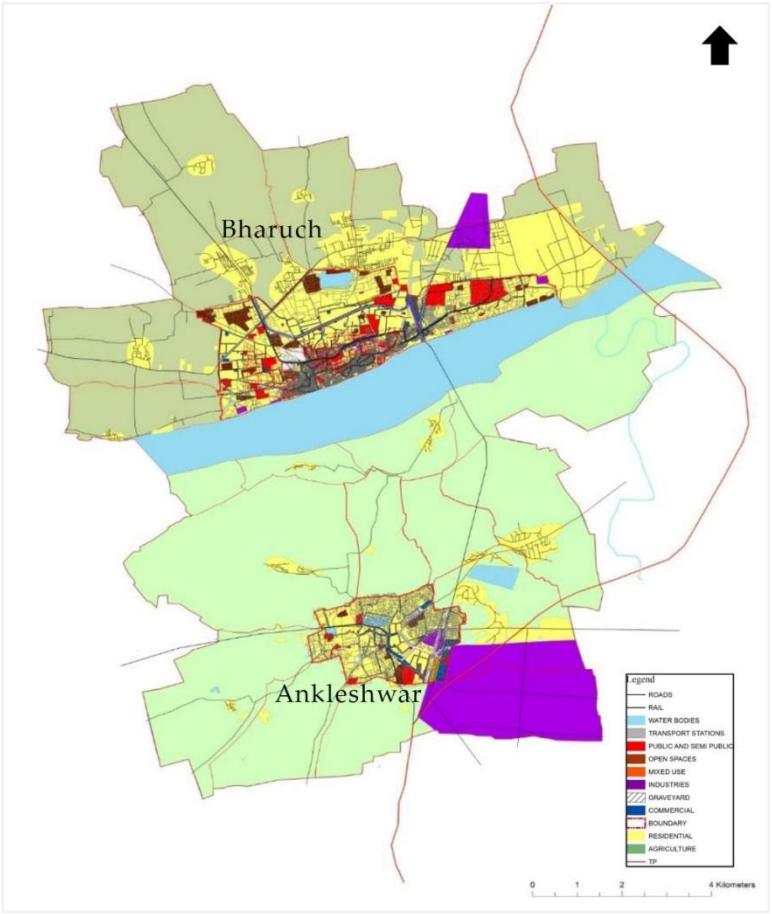
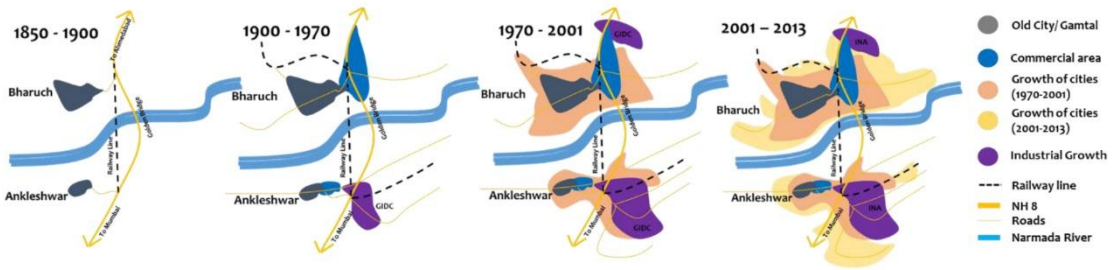
Figure 1 Land use map



III.GROWTH OF THE CITY

Bharuch and Ankleshwar cities which was formed on the either side of Narmada River and developed into municipalities. The eastern side, after Mumbai- Vadodara railway track had new development to extend up to the national highway. It is the fact that the railway track and the national highways are the major physical barriers for development.The northern part of the city is again restricted by the Bharuch-Dahej road. The GNFC and other industrial units are in the north side of the Bharuch city. The western side has development like APMC market and new apartment-commercial buildings. In Ankleshwar south east side of the city is occupied by GIDC Ankleshwar industrial estate and the development is seen surrounding the estate. Recently development had crossed the national highway and spotted development being taken place on Bharuch-Shuklatirth road which is state highway. The city's development pattern shows continuous residential growth dotted with institutional and commercial patches. This settlement structure is largely influenced by transportation corridors and industrial estates. Major institutions have come up all over these corridors. Urban expansion was determined by the supervised classification tools in ERDAS by comparing land cover in 2003 and 2013. And settlement pattern of the Bharuch and Ankleshwar was discussed from the 1850 to 2013.

Figure 2 Settlement pattern



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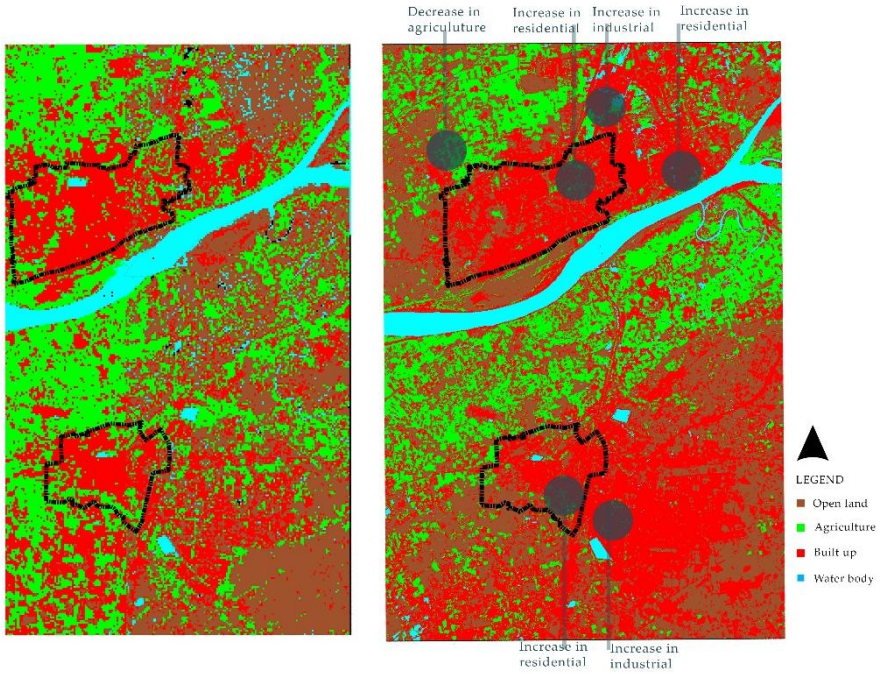
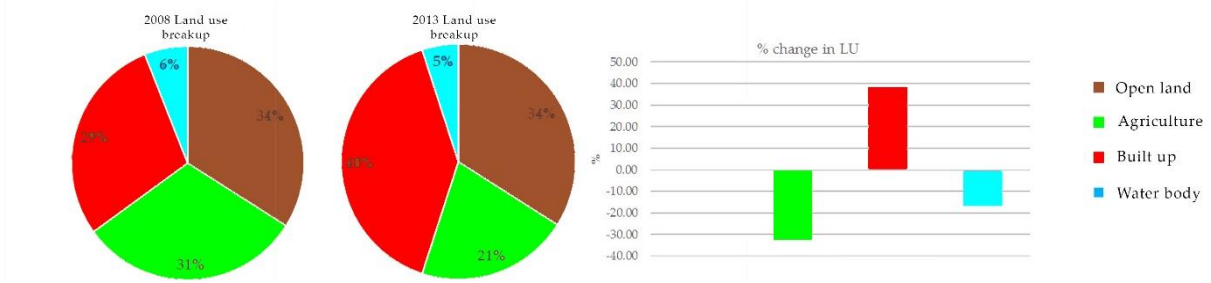
Growth of the city increases to 18 Sq.Km in Bharuch and 16 Sq. Km in Ankleshwar. In two cities there is increase in the residential & industrial areas on east directions. As compared to the Bharuch there high change in industrial area in Ankleshwar due to INA.

Figure 3 Land cover in 2008 and 2013



Land cover composition consists of four categories open land, agriculture/green spaces, built up and water body. In 2008 these are in percentage of 34%, 31%, 29%, 6% respectively. In 2013 these are in 34%, 21%, 40%, 5%` respectively. There is approximately 30% decrease in the agriculture area and approximately 40% increase in the built-up area.

Figure 4 Land cover breakup and % change in land cover



IV. DESIGNING THE FRAMEWORK FOR LAND SUITABILITY

This section discusses how the parameters are validated for the land suitability and GIS based approach. In this paper composite weighted method was used to rank and get final value for individual parameters.GIS tools helps in identifying the importance of the criteria used and to calculate weights by using a scale of importance and the opinion of experts Each phase involves a particular preparation to produce a final output map of land suitability on the basis of various types of criteria.The weights of factors can commonly be identified by using driven knowledge and driven data. The weights of factors can also be calculated by using a questionnaire given to specialists.

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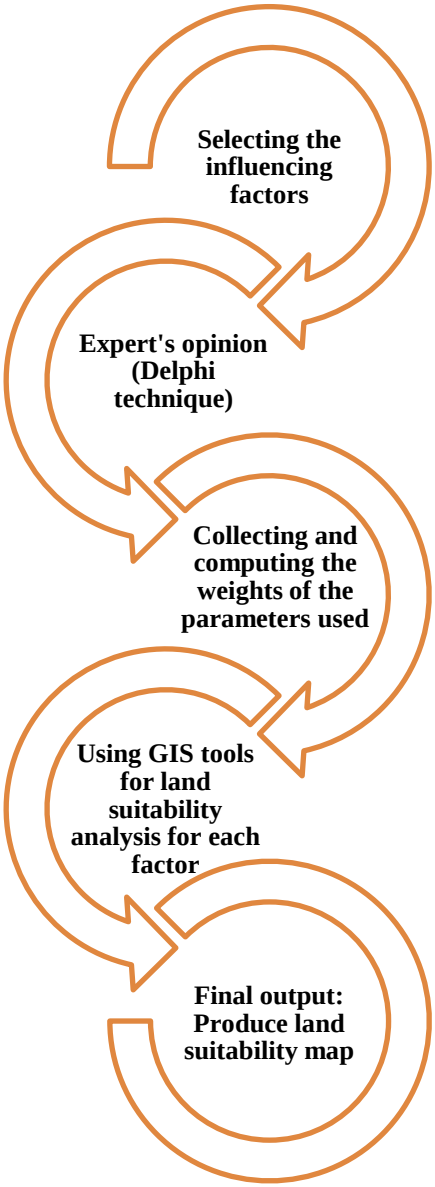
Figure 5Final output: Produce land suitability map



After finalizing the process of the land suitability procedure, next important segment is to finalise the parameters that influences the land suitability output. Overall influencing parameters are categorized into three types. These parameters will be differing from the place to place with the characteristics of the urban areas. Parameters that would be considered for the land suitability which are directly replicates the features of the Bharuch and Ankleshwar and extended area are Narmada river, slope, city boundaries, proximity to national highways, proximity to state highways and proximity to village roads. For all these six parameters weights and ranks are allotted by the Delphi technique. Table no 1 shows the weights and ranks for all these six parameters which are given by the experts by considering the existing situations of the Bharuch & Ankleshwar and surrounding villages.

Table 1 Criterion table

Parameters	Sub parameters	Ranks	Weightage
River	<100m	1	4
	100 to 300	2	
	>300m	3	
Slope	<7.8	3	8
	7.8 to 15	2	
	>15	1	

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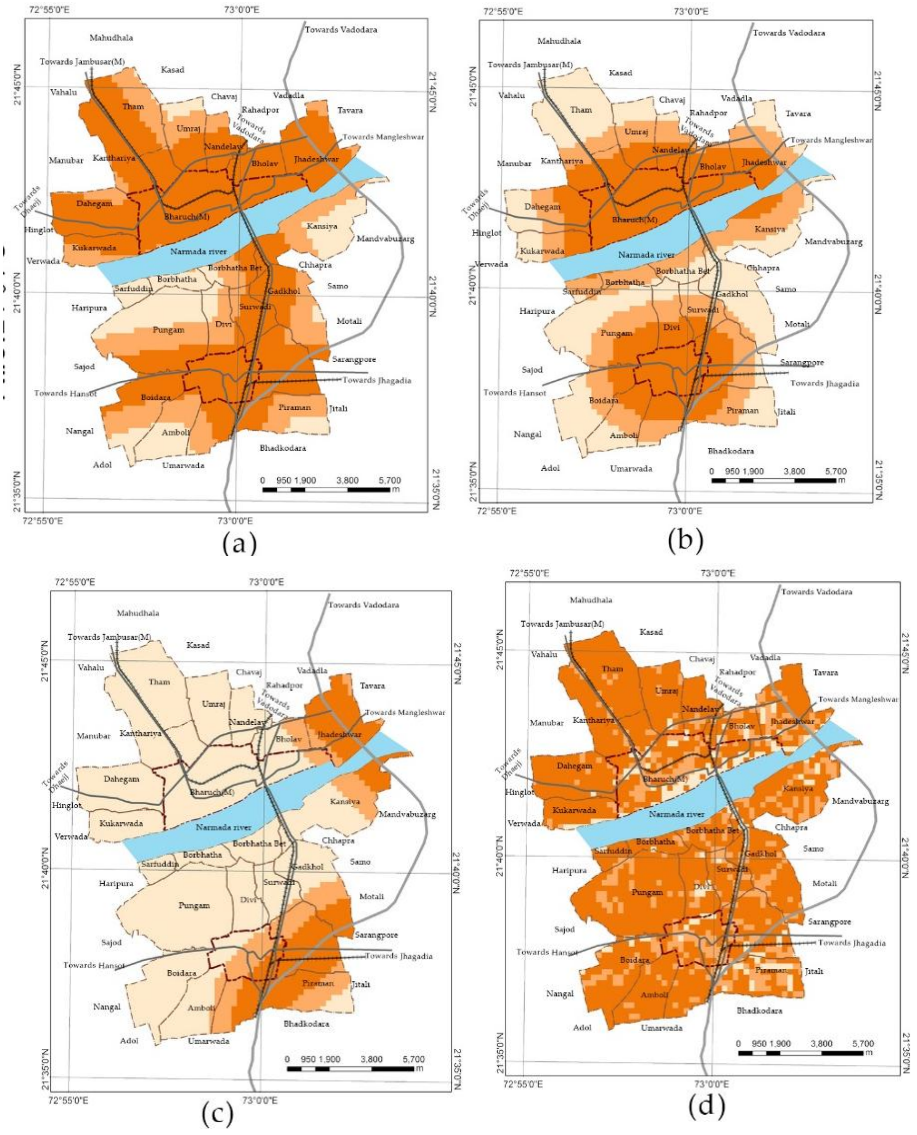
City boundary	<1Km	3	5
	1 to 2	2	
	> 2	1	
Proximity to NH	<1Km	3	8
	1 to 2	2	
	>2	1	
Proximity to SH	<1Km	3	8
	1 to 2	2	
	>2	1	
Proximity to village roads	<500m	3	8
	500 to 1000	2	
	>1000	1	

V. RESULTS AND DISCUSSIONS

In this part of the research, the significant factors that influence thedetermination of appropriate land suitability for future development activities in the Bharuch and Ankleshwar master plan. By using weighted index method under Arc GIS software, land suitability was developed for each parameter and overlay the all parameters to get final land suitability of the master plan development activities.



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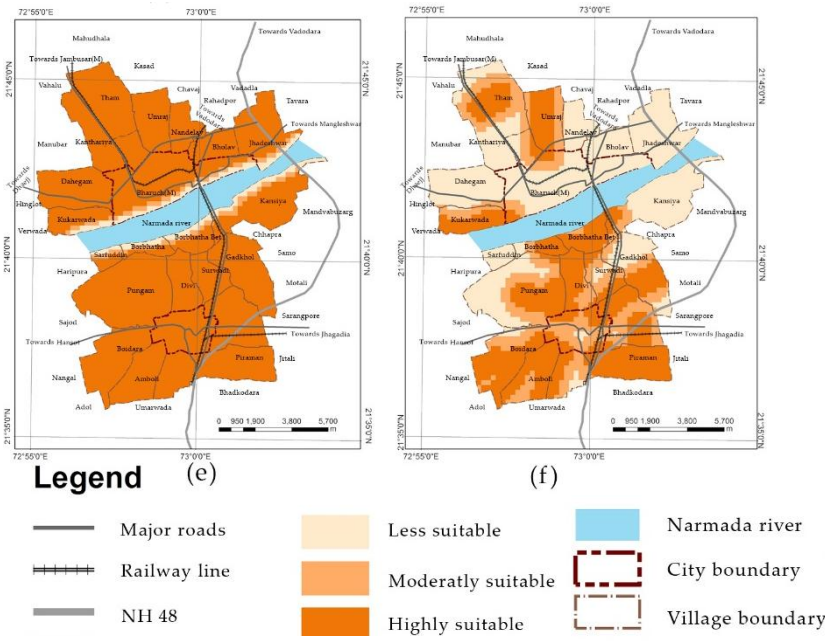

Figure 6(a) Proximity to state highway (b) city boundaries, (c) Proximity to National highway, (d) Slope, (e) Narmada river, (f) Proximity to village roads

VI. CONCLUSION

This study conducted a Land Suitability Analysis (LSA) to determine the suitable locations for urban growth in the master plan of Bharuch and Ankleshwar. Land suitability defines the relationship between the spatial parameters that allow the development activities. Land suitable was categorised into three types that are less suitable, moderately suitable and highly suitable.

Table 2 Land suitability categories

Category	Area	Percentage
Not suitable	44812500	44.81
Moderately suitable	53875000	53.88
Suitable	73875000	73.88

The final land suitability map provides spatialrepresentation of the inherent capability of the land to support development activities. This final land suitability map was developed by the overlaying the all six parameters using Arc GIS software. In addition, the findings show that the land on either side of the Narmada river was not suitable for development activities even tough it is in middle of the Bharuch and Ankleshwar because land was under the flood zone of Narmada river.

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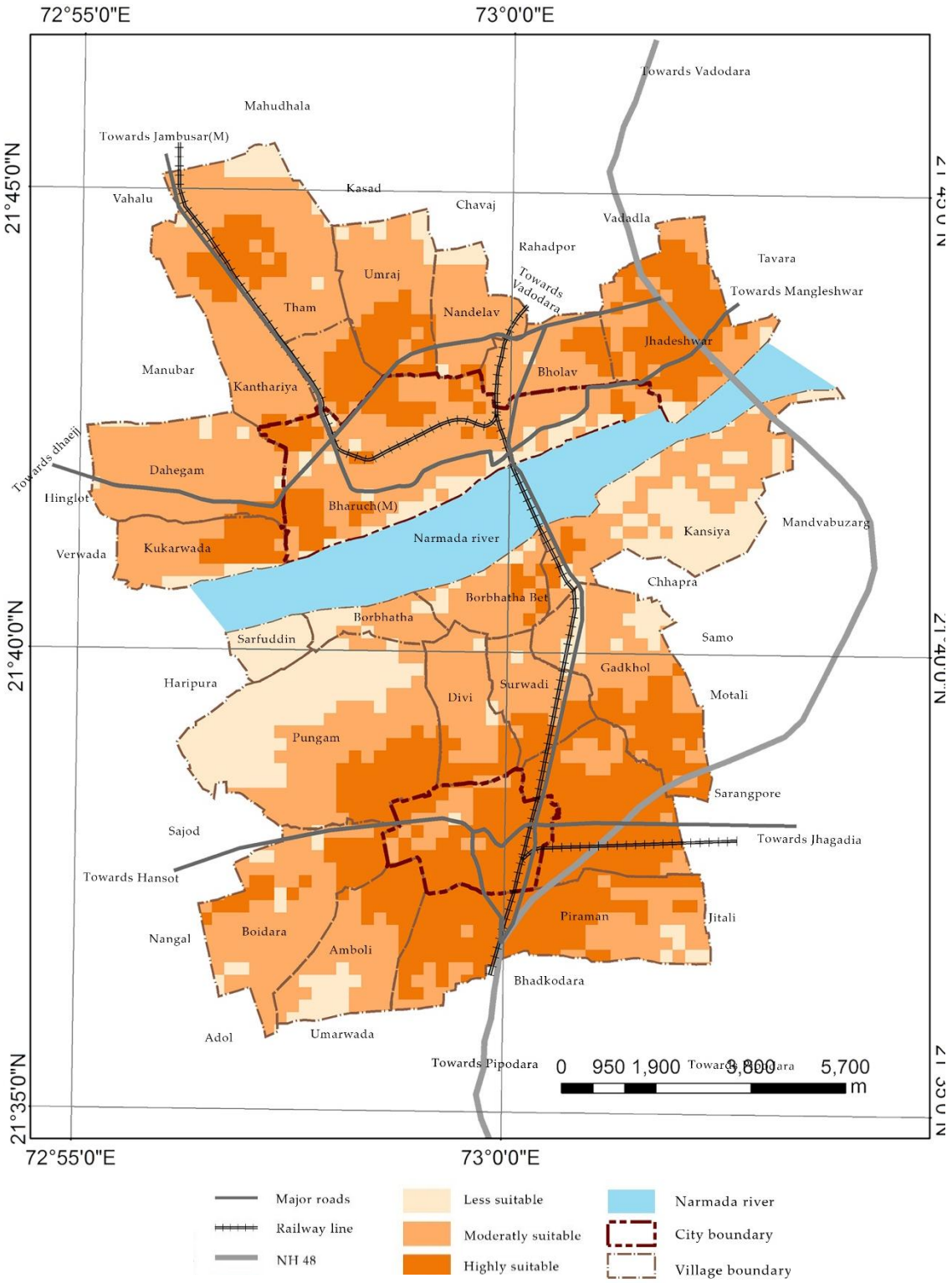
Figure 7 Final land suitability



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