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Ministry of Housing and Urban Affairs
Government of India

Paper Presentation

on

A GIS BASED APPROACH TO SOLVE SUSTAINABLE PORT HINTERLAND CONNECTIVITY BY PROPOSING OPTIMAL LOCATIONS OF DRY PORT USING A LOCATION ALLOCATION MODEL

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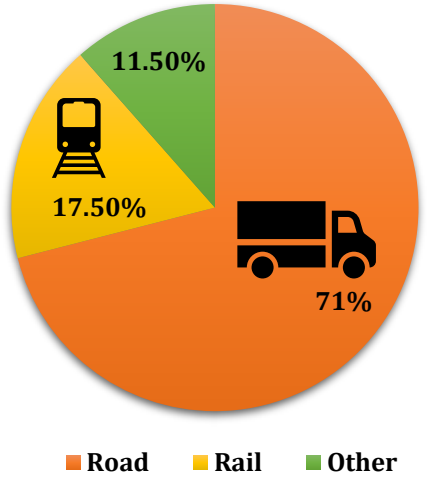
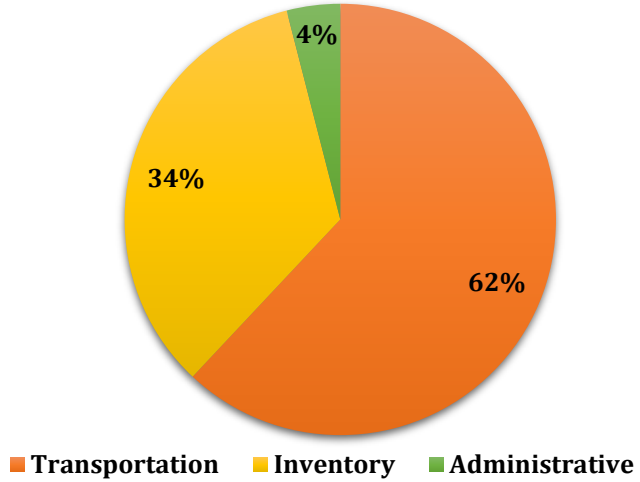
INTRODUCTION

- India is the fastest-growing economy and the fifth-largest economy in the world.
- It handles around **4.6 billion goods** each year and it generates **3 trillion ton-km** of transportation demand. In **2050**, the demand will increase to **15.6 trillion ton-km.**
- This generates the demand for more logistic hubs and freight transportation.
- Disadvantage of transport by road is congestion, CO_2 emission and time-consuming travelling for long-distance haul.
- The amount of CO_2 emission due to freight transport is 220 million tonnes and only road freight transport shares 95% of it. The projected CO_2 emission in 2050 is 1,214 million tonnes which will badly affect the environment.

Distribution of freight transport in India



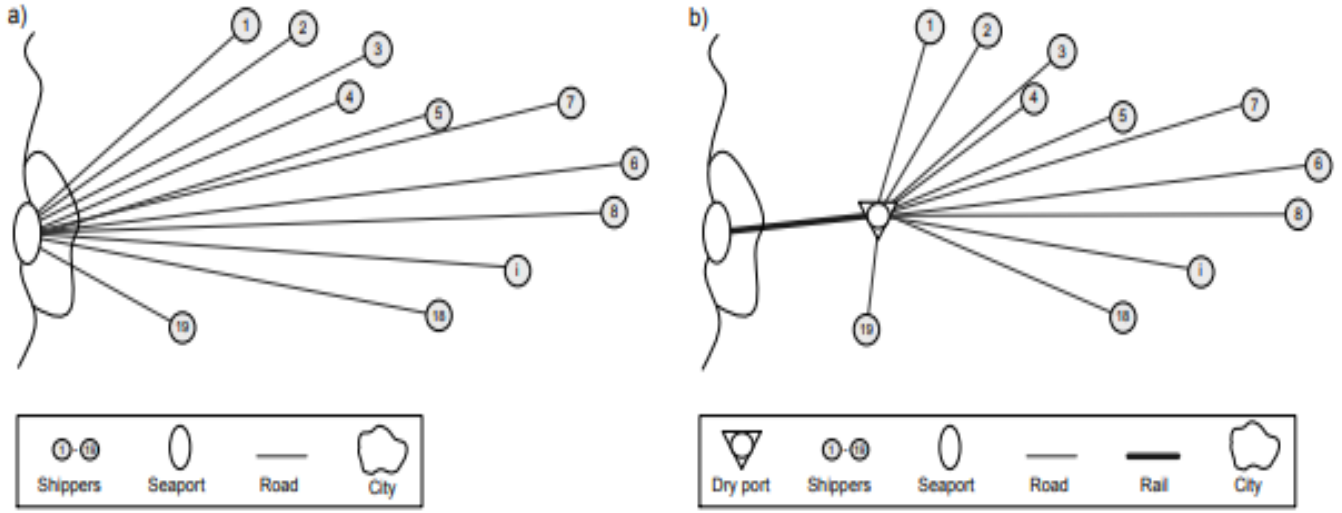
Composition of logistic cost in India (%)



INTRODUCTION

- In maritime transport, ports are the gateways for international trading but have physical limitation of expansion.
- With rising demand container transportation increases which causes congestion in the port cities, increase in dwelling time and wastage of perishable goods.
- Addressing these challenges requires a comprehensive approach involving strategic infrastructure planning, efficient intermodal transport networks, and sustainable practices to enhance trade facilitation and mitigate environmental impact on port cities.

Dry Port: To relieve connected seaport's pressure of overcapacity of freight and space limitation, to improve the inland port access, to help develop local region's trade economy, and to reduce contaminated emissions and accidents from road transportation and congestions

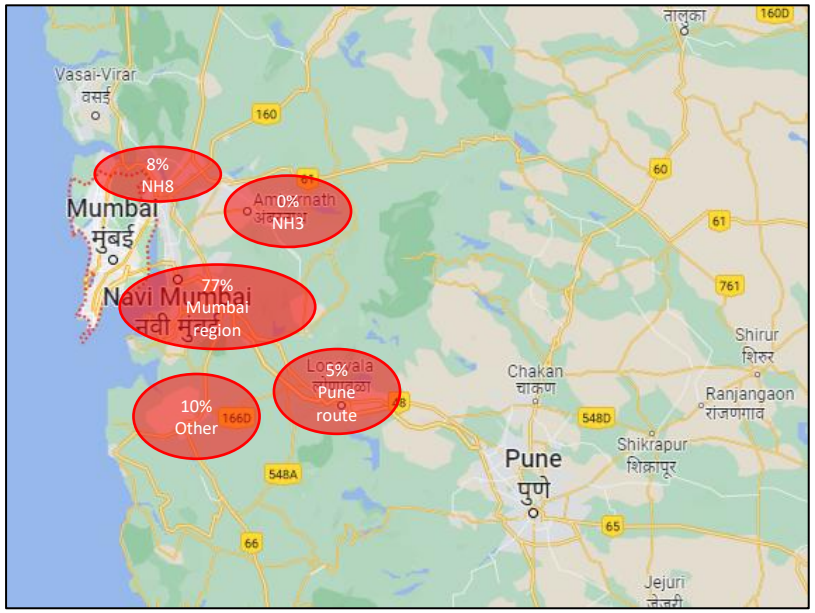


(Roso, 2009)

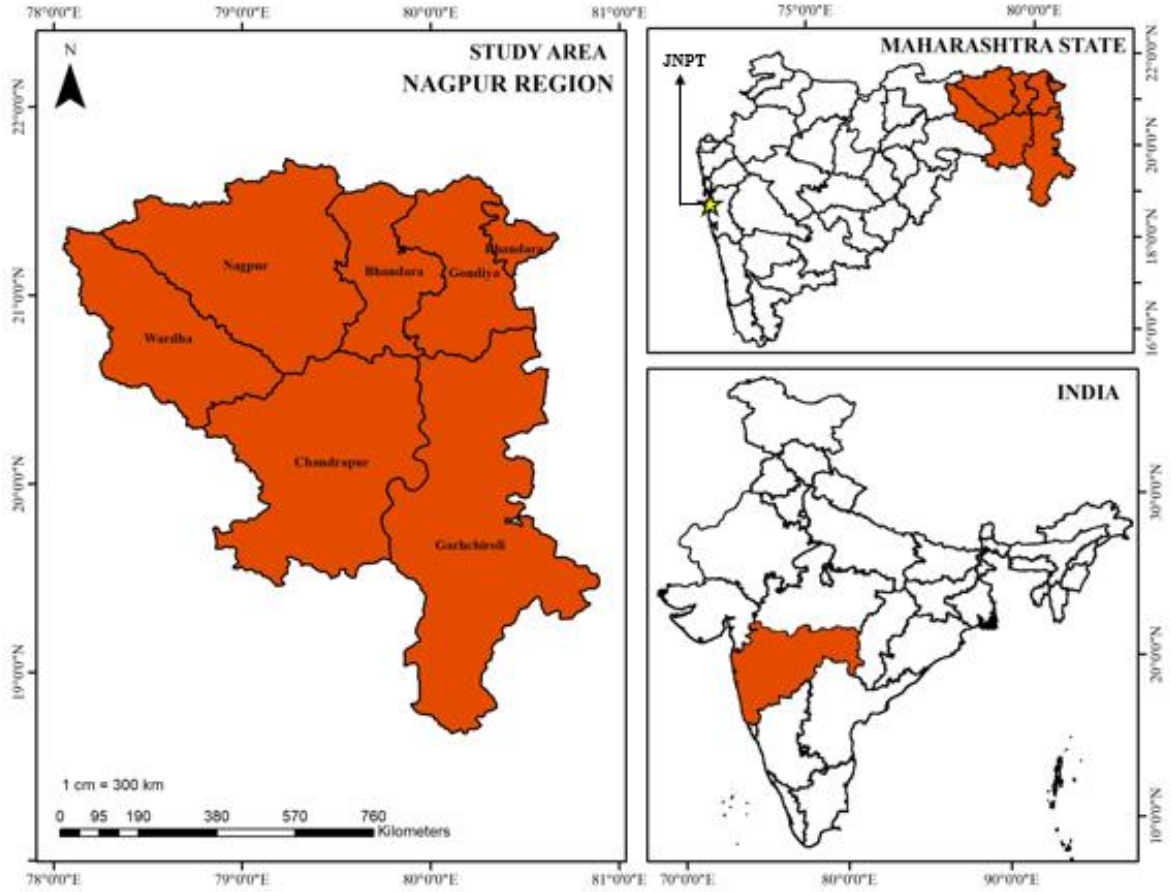
STUDY AREA PROFILE

CANDIDATE PORT: JAWAHARLAL NEHRU PORT

- It is the second largest port in India after Mundra port.
- The current capacity of port is 118.3 Million Tonnes Per Annum.
- Out of the total container travel to the port, 82% travel by road.
- The available capacity at JNPCT is not an issue because demand has been declining owing to competition over the past few years.
- Low rail coefficient.



(Logistics Databank Analytics Report-JNPA, 2022)



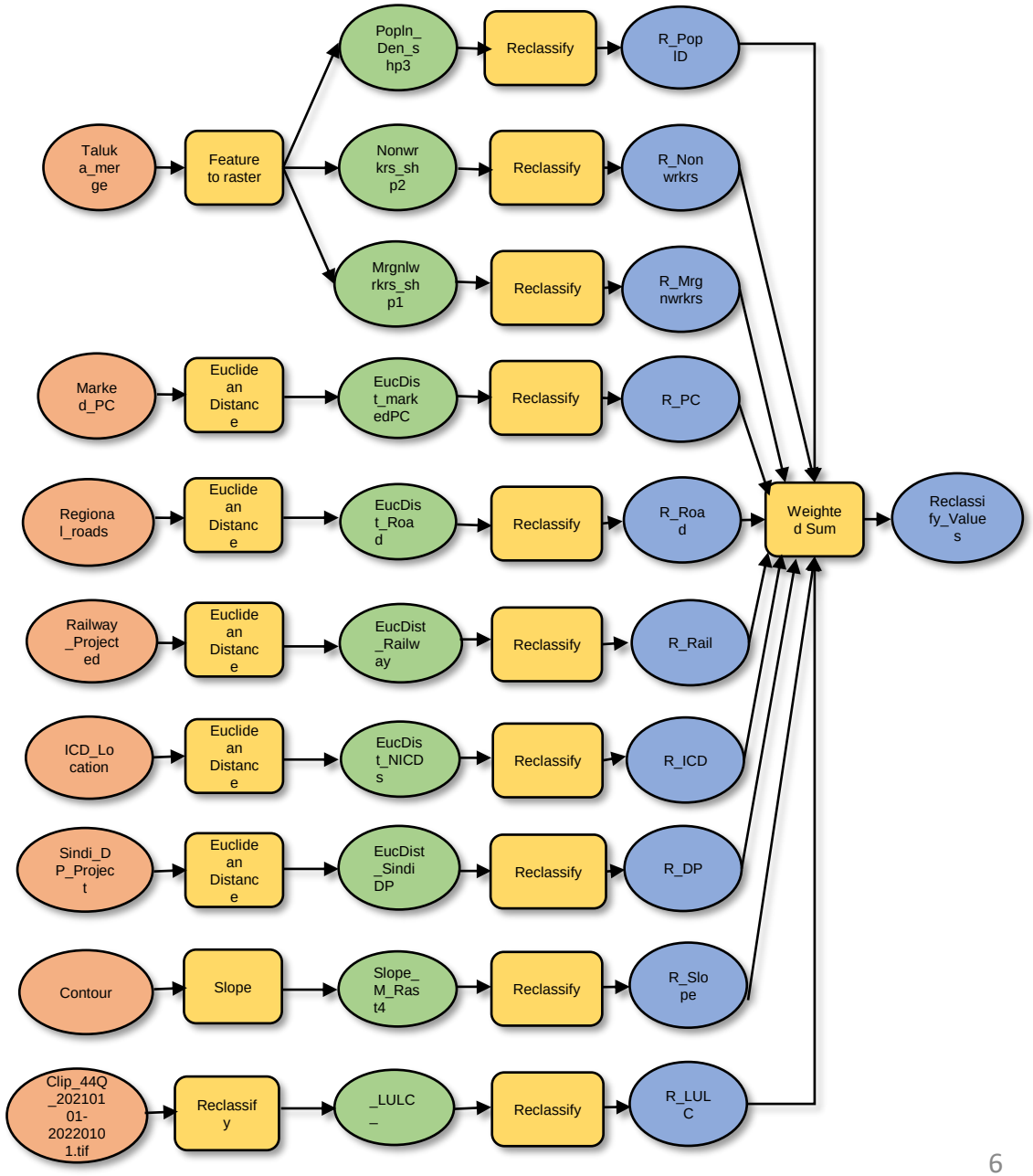
STUDY AREA: NAGPUR REGION

- Total area is 51599 sq. km and lies in the shades of JNPT.
- The Nagpur region is located in the central part of India surrounded by numerous economic activities.
- Has high potential of attracting freight traffic from all the corners of the country

LAND SUITABILITY ANALYSIS

- The ‘land suitability analysis’ is done in ArcGIS to reduce the large area into small areas of suitable land parcels.
- A spatial analyst tool that enables to evaluate, compare, and rank potential land parcels according to how closely they meet chosen and defined criteria.

Sr. No.	Parameters
1.	Away from high population density
2.	Proximity to Non-working population
3.	Proximity to Marginal working population
4.	Proximity to Production centers
5.	Access to Road
6.	Access to Rail
7.	Slope of terrain
8.	Land Use Land Cover
9.	Away from the existing ICD location
10.	Away from the existing ICD location



LAND SUITABILITY ANALYSIS

CRITERIA WEIGHTS

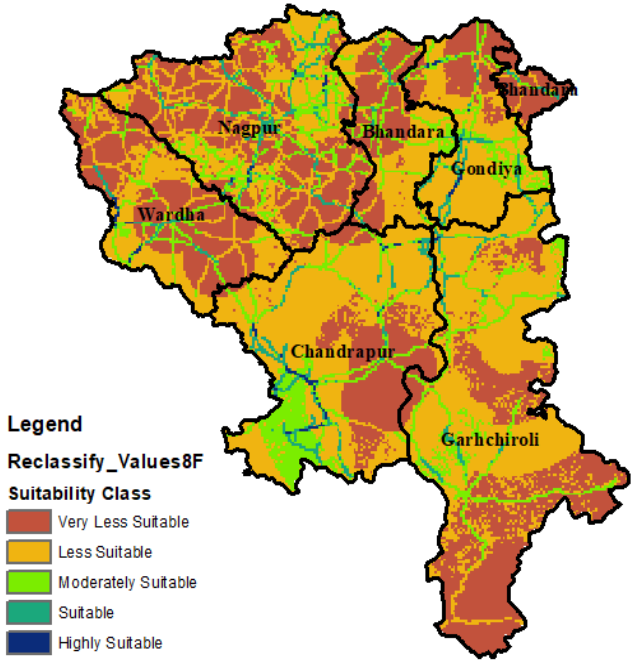
- The analysis is performed for two cases

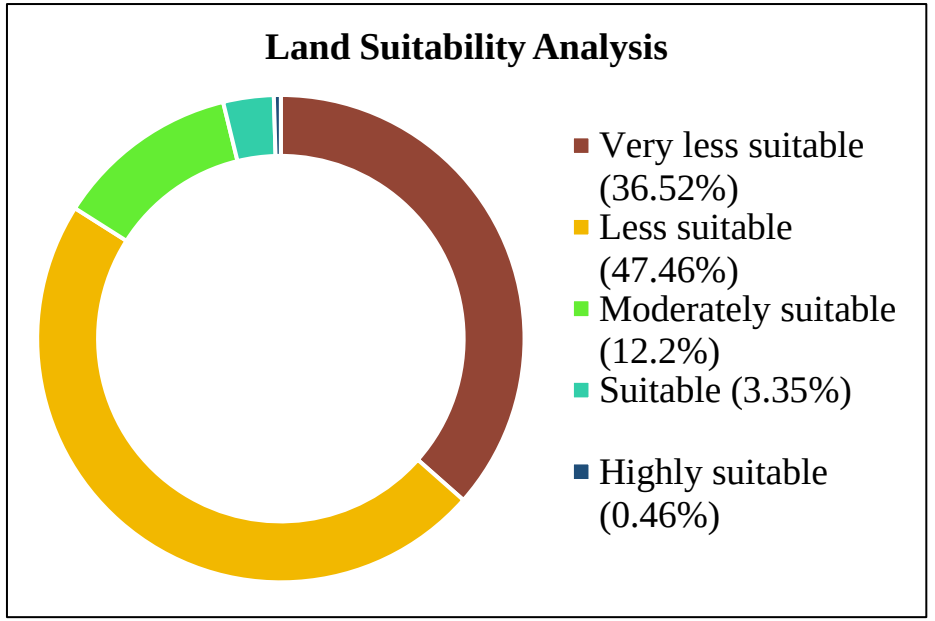
1. Only eight parameters are considered except 'Away from existing Dry port' and Away from existing ICDs' which provide suitable locations over all the region
2. All ten parameters are considered in which result will give suitable land away from existing ICDs and Dry Port.

Sr. No.	Parameters	Weightage (%)	
		Case 1	Case 2
1.	Away from high population density	3.8	3.3
2.	Proximity to Non-working population	4.8	1.9
3.	Proximity to Marginal working population	8.3	5
4.	Proximity to Production centers	38	14.8
5.	Access to Road	16.6	8.1
6.	Access to Rail	20.4	9.0
7.	Slope of terrain	4	2.9
8.	Land Use Land Cover	4.1	2.4
9.	Away from the existing ICD location	-	26.3
10.	Away from the existing ICD location	-	26.3

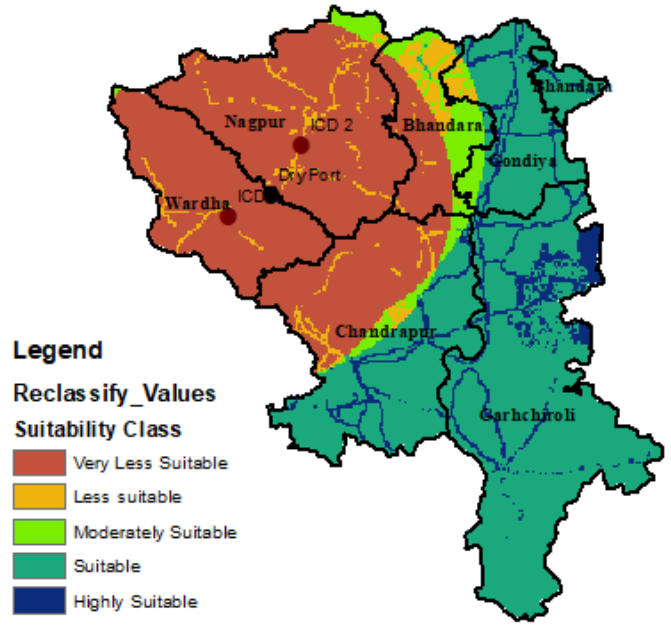
FINAL RESULTS OF SUITABLE LAND PARCELS

Case 1





Case 2

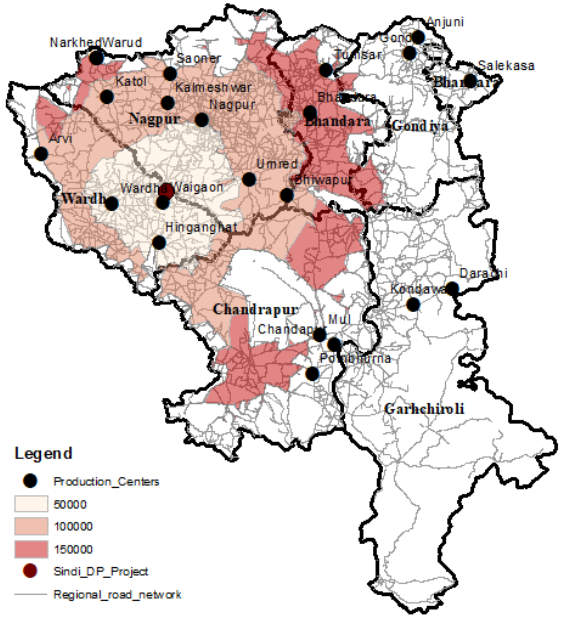


LOCATION ALLOCATION MODEL

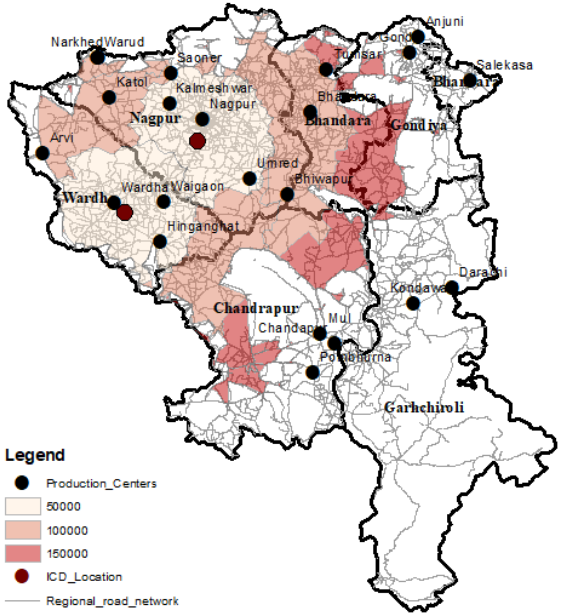
- A geographic information system's algorithm is used in location-allocation to choose the optimum location for one or more facilities that will best serve a particular collection of demand points.

SERVICE AREA ANALYSIS

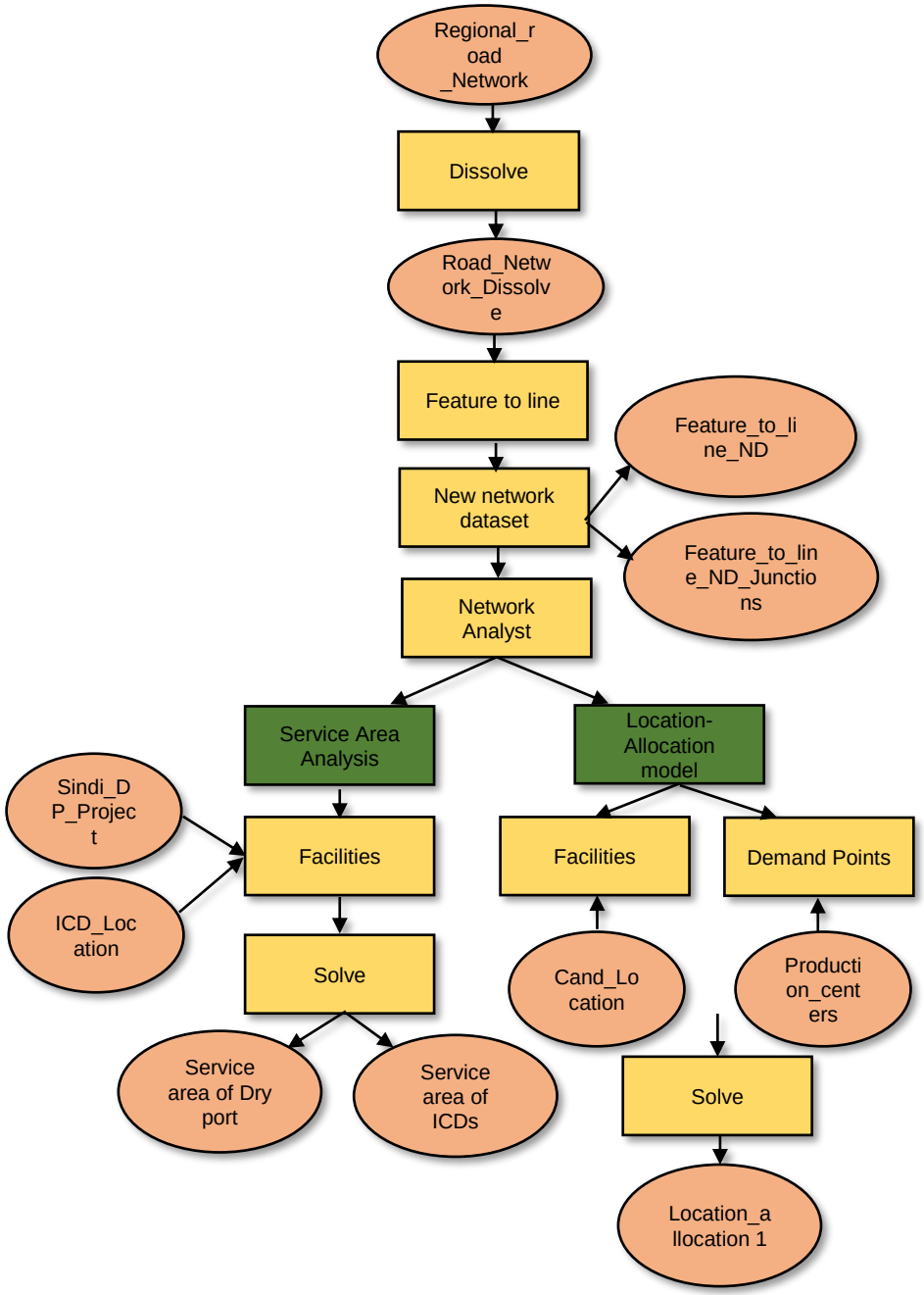
Service area analysis of existing Dry Port.



Service area analysis of existing ICDs.



- To perform the analysis the impedance of length is given as 50 km, 100 km, and 150 Km.
- Total 8 Production centers lies beyond 150 km radius.
- Hence new locations of inland hubs are needed to serve the remaining production centers.

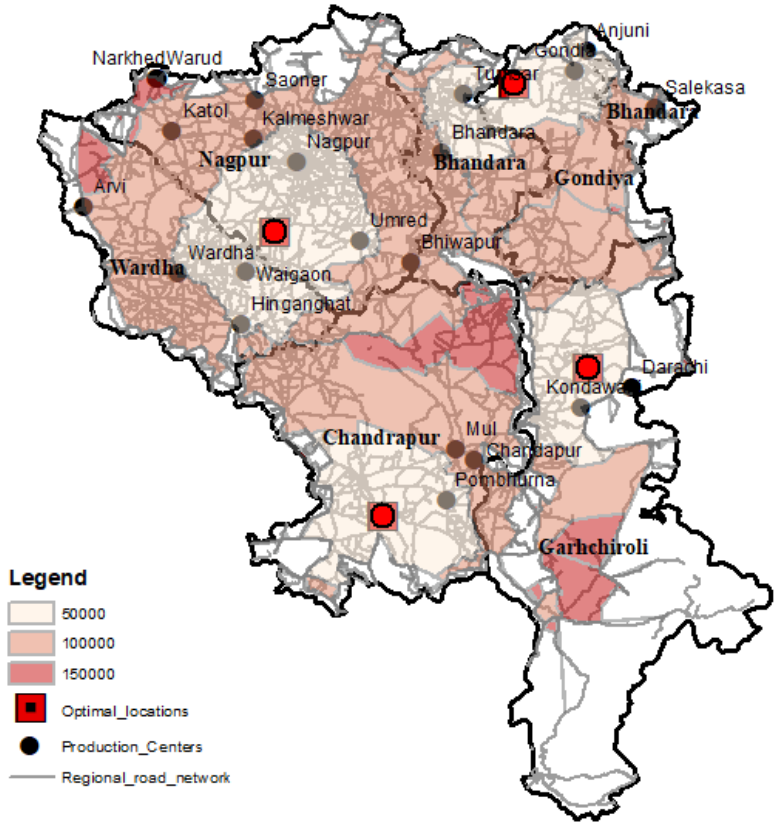


LOCATION ALLOCATION MODEL

FINAL OPTIMAL LOCATIONS OF DRY PORT

- Problem type is Minimize impedance: it reduces the overall distance the container needs to travel to reach the chosen facility and hence it saves the cost.
- The impedance cut-off is set to 100 km.
- Input of 4 facilities is chosen as a sufficient criterion to provide optimal locations of dry ports since it covers maximum production centers in 100 km impedance which is not so close and not so far.

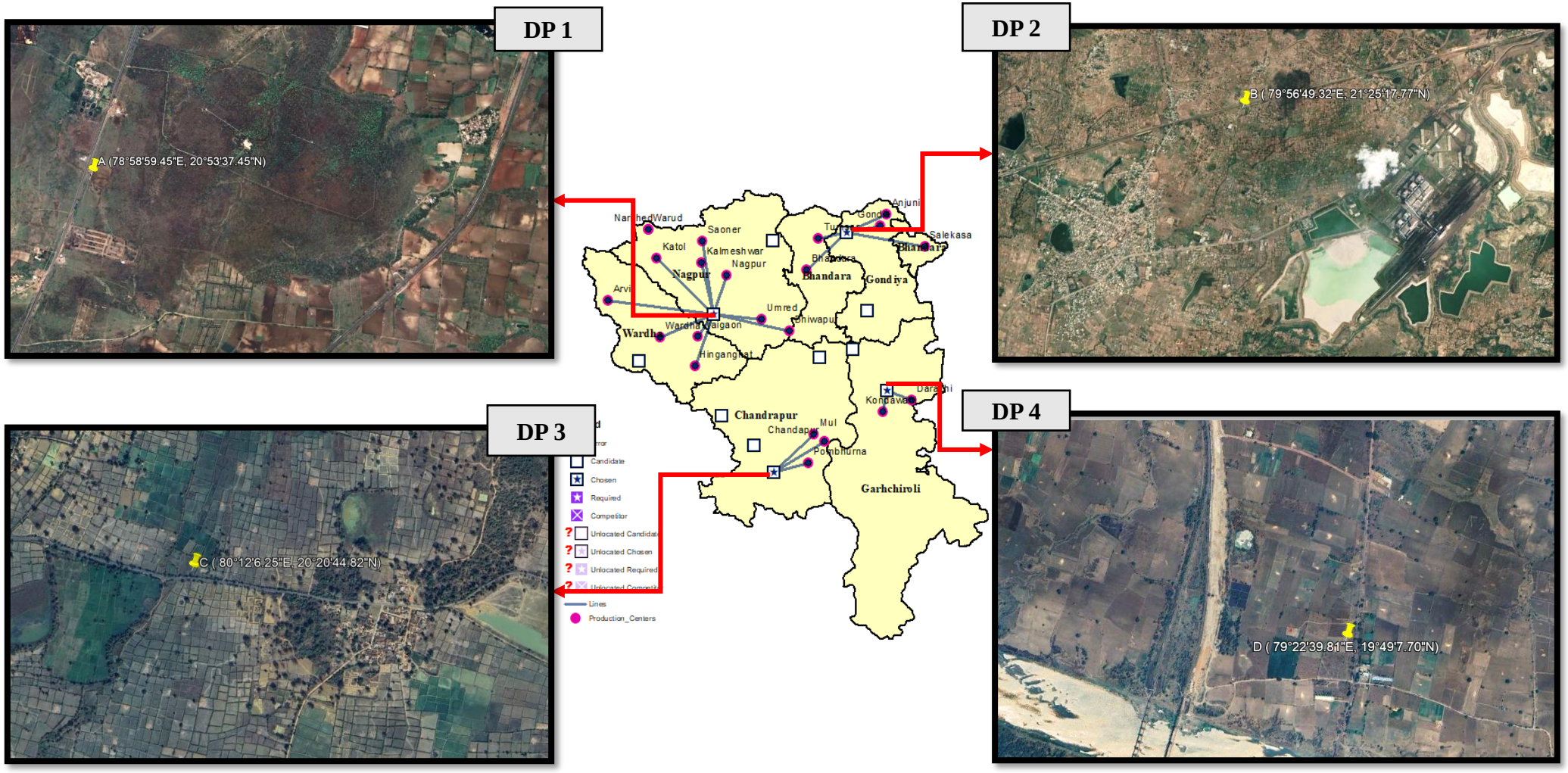
SERVICE AREA ANALYSIS



LOCATION ALLOCATION MODEL

Nagpur district on the Srinagar-Kanyakumari highway (NH 44) near Butibori.

Gondia district near Tirora along NH 753 and the railway line



Chandrapur district along Mancherial-Chandrapur-Nagpur road near to Ballarpur.

Gadchiroli district along SH 269 near Bori.

MEASUREMEN OF EFFICIENCY OF TRANSPORT BY RAIL

Sr. No.	Origin	Destination	Distance (km)		GHG emission (tCO_2)		Cost breakup (in Rs)	
			Road	Rail	Road	Rail	Road	Rail
							Total (Freight + environment)	Total (Freight + environment)
1.	Production centers of Cluster 2	JNPT	**4778**	4829	**86.13**	21.99	**5,335,384**	23,74,427
2.	Production centers of Cluster 2	DP 2	**308**	272	**0.21**	0.025	**13,677**	51,058
	DP 2	JNPT	953	**944**	85.95	**21.5**	53,20,896	**27,61,955**
	Total GHG emission		21.5 +0.21=**21.71**				13,677+27,61,955=**2,775,632**	

- Here it is observed that the total GHG emission by road in the first case is 86.13 t CO_2 and in the second case as a result of modal share the GHG emission is 21.71 tCO_2 which is reduced by 74.8%.
- Now, in the case of cost, the total cost of traveling by truck from the production centre to the port is Rs. 5,335,384 and the cost estimated in the second case is Rs. 2,775,632 which is reduced by 48%.
- Hence the modal share is an efficient solution to choose over direct delivery by truck since it reduces CO_2 emission and overall transportation costs.

CONCLUSION

- The huge hinterland of the country needs an efficient freight transport network plan by shifting majority of the freight transport to rail and location planning of dry ports which reduces burden on port as well as impact on environment and support country for economic growth.
- the methodology followed to identify locations of dry port is feasible to carry out the analysis for any scale of work by considering different parameters.
- If a one district can reduce GHG emission (74.8%) and travel cost (48%) then planning a efficient multimodal network of dry port and increase the share of rail for whole country can impact on huge level of reduction in share of transportation cost and healthy environment surrounding the logistic activities.
- Policies need to be developed with a primary goal of consolidating complex logistical data into a single platform.
- The policy framework should emphasize the importance of engaging relevant stakeholders, including local communities, businesses, trade associations, and transportation providers.
- To mitigate the creation of heat islands within urban areas, it is advisable to encourage the development of Dry ports outside of the city limits.
- Each port should prioritize the enhancement of its rail infrastructure network within the designated operational zone to promote sustainable freight movement.

Thank You