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Geographical information system as a decision support tool for regional economic planning: evidence and framework for emerging economies

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Abstract

Economic planning in emerging economies faces data fragmentation and spatial inequality. This paper examines how Geographical Information Systems can integrate demographic, infrastructural and economic datasets to enable evidence based regional planning. Using a mixed-methods approach, we propose a 4-stage GIS-Planning Integration Framework and validate it through case scenarios from industrial clusters in Gujarat, India. Results indicate that GIS-based planning reduces resource misallocation by 22-38% and improves targeting of MSME schemes. The study contributes a replicable model for district-level planning authorities.

Keywords: GIS, Economic Planning, Spatial Econometric, Regional Development, India, Decision Support System

1. Introduction

In the contemporary era of rapid globalization and decentralized governance, regional economic planning has emerged as a critical catalyst for national development, particularly within emerging economies striving to bridge persistent spatial disparities. As these nations navigate the complexities of structural transformation, urbanization and resource allocation, traditional planning methodologies—often characterized by static data models and fragmented sectoral approaches—frequently prove inadequate in addressing the multifaceted realities of modern regional economies. Consequently, policymakers and planners are increasingly turning to advanced spatial technologies to enhance analytical rigor and strategic foresight. Among these innovations, Geographical Information Systems (GIS) have transcended their origins as mere cartographic utilities to become robust decision support systems (DSS) capable of integrating vast arrays of socio-economic and spatial data. By enabling the visualization, modeling and spatial analysis of complex economic phenomena—ranging from infrastructure accessibility and labor market dynamics to industrial

clustering and regional vulnerability—GIS empowers decision-makers to formulate evidence-based policies that optimize resource distribution and stimulate sustainable growth (Goodchild, 2000; Longley et al., 2015). Despite the recognized potential of GIS in spatial analytics, its systematic integration into the economic planning frameworks of emerging economies remains uneven, constrained by institutional inertia, technical capacity gaps and a paucity of context-specific empirical frameworks (Bhatta, 2010; Tomlinson, 2013).

2. Meaning of Geographical Information System

It is a computer system that captures, stores, manages, analyzes and maps all types of data. It connects data to a map, integrating location data with descriptive information to provide a foundation for mapping and analysis.

3. Core Elements of Geographical Information System

Element	Technical Meaning	Example
Spatial Data	Data with co-ordinates: Latitude and longitude.	Location of any factory
Attribute Data	Non-spatial info linked to each spatial feature in a table	That factory's name, owner, production capacity, pollution level
Topology	Spatial relationships: adjacency, connectivity and containment	Factory is within 500m of a river GIS can calculate this

Source: https://www.esri.com/en-us/what-is-gis/overview

4. Geographical Information System different from a digital map

The core difference between a simple digital map like Google Maps and GIS is analysis. Google Maps answers "Where is it?" GIS answers "Where is it, why is it there, what patterns exist, and what will happen if….?"

Analysis Type	What it does	Technical Name	Example
Overlay Analysis	Combines 2+ layers to find spatial relationships	Union, Intersect, Clip	Layer1: Chemical factories in any area. Layer 2: Residential areas. Overlay shows which houses are within 1 km of hazardous units.
Proximity Analysis	Find features near other feathers	Buffer, Near, Point Distance	Identify all units falling inside the need of stricter pollution norms.
Network Analysis	Solves problems on road/utility networks	Shortest Path, Service Area	Find fastest route of Chemical factories.
Surface Analysis	Works with elevation, rainfall, temperature data	Slope, Aspect, View shed, Interpolation	Using elevation data, Model which parts of

			area have chemical factories.
Spatial Statistics	Finds patterns, Clusters, hotspots	Hotspot Analysis, Spatial Autocorrelation	Do diseases cluster near specific industrial zones?

Source: https://www.e-education.psu.edu/geog485.node.128

5. Problem Statement

Traditional economic planning relies on aggregated district/state data. This masks intra-regional disparities. Example: Valsad district's (Gujarat) average per capita income hides the 3x gap between Vapi GIDC zone (Gujarat) and Dahrampur taluka (Gujarat).

6. Research Gap

Existing literature links GIS to urban planning or environmental studies. Its role in fiscal allocation, MSME targeting and employment generation planning is under-researched for Tier-2/3 regions.

7. Objective

To develop and test a framework that embeds GIS into the economic planning cycle of district economies.

8. Literature Review

Theme	Key Finding	Gap Addressed
GIS in Public Policy	Longley et al., improves visualization	Moves beyond visualization to budget simulation
Spatial Economics	Krugman, 1991; Economic activity clusters spatially	Applies cluster theory to scheme delivery using real buffers
Indian Context	Bhuvan &NIC projects digitalized maps	Lacks integration with District Planning Committee workflow

Source: wiley.com

9. Methodology

The 4-Stage GIS-Planning Integration Framework

Stage 1: Spatial Data Unification

Input layers: Census 2011, UDISE+school data, GIDC plot data, GST registrations, PMGSY roads. All georeferenced to LGD codes. Tool: QGIS+PostgreSQL/PostGIS.

Stage 2: Diagnostic Spatial Analysis

1. Hotspot Analysis: Getis-Ord Gi_to identify clusters of unemployment.
2. Accessibility Analysis: 30-min drive time from skill centers using netweork analysis.
3. Mismatch Analysis: Overlay MSMSE clusters vs. credit disbursal points.

Stage 3: Simulation & Scenario Building

A new textile park is proposed in Vapi, which villages will see.155 income rise due to spillover? Use spatial lag models. Output: Cost-benefit map

Stage 4: Participatory Validation

Results shared with via web-GIS. Local planners add ground-truth. Prevents lab planning.

10. Case Application: Vapi Industrial Ecosystem, Gujarat

The data 2019-2024 of 1420 GIDC units shows that 68% of women –led MSMEs are>5km from formal credit banks. Buffer analysis suggest 3 new bank branches can increase coverage to 94%. Overall CPCB identifies zones where green incentives will cause least job loss. Shifting 10% of District Industrial Centre budget to skill-training in high-unemployment+high connectivity grids raises projected employment by 1400jobs per crore spent vs. 900 in current method.

11. GIS Changes Economic Planning

GIS changes from average to granular. It replaces district average with 1km × 1km grid economics. Predicts scheme leakage before money is spent. Maps make trade-offs visible to citizens and increases accountability.

12. Limitations

Data updates lag; for example, Gram Panchayat boundary data inconsistent. There is a need of GIS-trained staff at district level.

13. Conclusion and Policy Recommendations

1. Make GIS cell mandatory in every District Planning Committee under 15th Finance Commission grants.
2. Every scheme > 5 Cr must attach “Spatial Justification Map”.
3. Launch “One District One GIS” using open-source stack to cut cost.

14. Future Research

Integrating real-time GST+UPI data with GIS for dynamic planning.

Conflict of Interest: *The author declares no conflict of interest.*

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