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Operational suitability and strategic framework for integrated area development: a longitudinal analysis of Narayanganj Sadar Upazila, Bangladesh

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ABSTRACT

This research evaluates the operational suitability of Integrated Area Development (IAD) in Narayanganj Sadar Upazila, a critical industrial hub in Bangladesh facing severe spatial fragmentation and jurisdiction conflicts. Utilizing a mixed-methods approach, the study employed a two-stage sampling method surveying 200 inhabitants across the Fatullah Union and Ward 9 of the Narayanganj City Corporation, supplemented by Key Informant Interviews (KII) with local administrative officials. The investigation integrates preliminary data from the 2022 Population and Housing Census (PHC), which reveals that the Upazila population has reached 1,770,734 with a staggering density of 17,577 persons per square kilometer. Spatial analysis identifies massive planning gaps when existing infrastructure is measured against the Detailed Area Plan (DAP) 2022-2035 and LGED standards, including a residential land deficit of over 29,000 acres and a circulation network restricted to only 5% of the land area. The research highlights the transition from the wetland-focused DAP 2010 to the 2022 framework, which prioritizes livability, functionality, and resilience. Results indicate that rapid industrial sprawl has significantly degraded the secondary economic base of rural inhabitants and strained utility continuity. To address these challenges, the paper proposes a 15-year strategic implementation framework categorized into social, physical, and economic pillars. Key recommendations include adopting the "School District Concept," promoting vertical compact growth, and leveraging innovative green finance instruments and sovereign green bonds to fund climate-resilient infrastructure.

1. Introduction

Integrated Area Development (IAD) stands as a foundational paradigm in the contemporary discourse on spatial management and regional equity. As global urbanization shifts toward more complex, interconnected systems, the traditional sectoral approaches to planning have increasingly proven inadequate. The conceptual core of IAD involves the harmonization of social, economic, and physical development within a defined spatial unit to respond to geographical concentrations of disadvantage and the fragmented nature of modern governance. In the context of 2023, the necessity for such integration is punctuated by the release of Bangladesh's Draft Data Protection Act 2023 and the overarching push for "Driving change with quality statistics and data for everyone". Accurate, high-quality data is now recognized as the essential ingredient for policy formulation, where inaccurate statistics can lead to devastating developmental outcomes.

The 2022 Population and Housing Census (PHC) results underscore the urgency of this integrated approach. Bangladesh's population has grown to 165.16 million, with a national density of 1,119 persons per square kilometer. Recent data updates from the landmark work of Hussain and Dill (2023) emphasize the critical role of green finance and climate-resilient strategies in regional development. Their findings indicate that sovereign green bonds and ESG (Environmental, Social, and Governance) frameworks are

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becoming primary instruments for financing sustainable infrastructure in the Global South, with India and Bangladesh emerging as key players in this transition. This 2023 context necessitates a shift in local planning from mere physical layout to a comprehensive, finance-driven, and data-protected governance model. The "DILL 2023" update specifically highlights the integration of climate adaptation into national development planning, identifying the Planning Information System (PLIS) as a GIS-based tool developed to help officials appraise investment projects with a resilience lens.

In Bangladesh, the spatial challenges are particularly acute. Densely developed regions such as Narayanganj increasingly require integrated planning approaches to optimize limited space and develop coherent, sustainable areas. Traditionally, land use functions have been split among several planning sectors urban, rural, infrastructural, and environmental often ignoring the vital interrelationships between these functions. This fragmentation causes individual stakeholders to focus on specific sectoral pressures rather than the area as a whole, resulting in non-harmonized policies and administrative inefficiencies.

Narayanganj Sadar Upazila serves as a poignant case study for these challenges. As a vital industrial hub and the "economic backbone" of Bangladesh, it contributes approximately BDT 3000 million daily in trade and commerce transactions. However, the area faces significant jurisdiction conflicts due to the coexistence of the Narayanganj City Corporation (NCC), established in 2011, alongside traditional Upazila and Union Parishad structures. This research aims to examine the operational suitability of IAD at the Upazila level in Narayanganj Sadar. The objectives include examining the conceptual basis of IAD, exploring existing physical and socio-economic conditions, evaluating IAD as a planning tool based on case study data, and offering strategic recommendations for practicing IAD in the broader Bangladeshi context. According to the BBS 2022 Census, Narayanganj Sadar Upazila has reached a population of 1,770,734, with a staggering density of 17,577 persons per square kilometer. This research aims to examine the operational suitability of IAD at the Upazila level in Narayanganj Sadar. The objectives include examining the conceptual basis of IAD, exploring existing physical and socio-economic conditions, evaluating IAD as a planning tool based on case study data, and offering strategic recommendations for practicing IAD in the broader Bangladeshi context.

The significance of this study lies in its potential to bridge the gap between planning and development. By developing a strategic process design, this research offers a pathway for project managers and policymakers to overcome barriers such as fragmented resources (manpower, finance, land) and the difficulties of involving key stakeholders at early stages of development. As local governance is a fundamental pillar of democratic development, connecting citizens with institutions through the Union Parishad and Upazila systems is essential for equitable service delivery. The 2023 data-driven landscape demands that these local government institutes (LGIs) evolve into more effective, inclusive, and resilient bodies.

2. Literature review

The scholarly debate surrounding Integrated Area Development has evolved from simple physical coordination to a holistic "spatial integration" of development activities. Bhat (1988) argued that IAD should lay stress on the interrelationship between social services, economic activities, and human settlements, treating urban centers and rural hinterlands as interrelated "nodes" within a functional economic entity. This perspective is further refined by De Kort (2009), who defines IAD as the "holistic spatial development of various interrelated land use functions by multiple stakeholders at various administrative levels". This definition encapsulates the shift from government-centric planning to governance-based collaborative processes.

2.1. Evolution of integrated development models

Integrated Rural Development (IRD), a precursor and subset of IAD, gained popularity in the 1970s as a means to improve community well-being in economic and environmental terms. However, early IRD projects often faced unsatisfactory performance evaluations, leading to a shift toward

broader systemic poverty alleviation initiatives like the World Bank's Poverty Reduction Strategies. The lessons learned from these shortfalls prompted a paradigm shift toward a new rural development model that clarifies how new resource bases are created and how the "newly emerging whole" orients toward new needs and interests.

Nemes (2005) proposed an integrated system where local and central development systems work in dynamic cooperation. In this model, control and responsibility are dispersed throughout different levels, and the existence of advanced local development institutions is a necessary condition. This approach lowers transaction costs by processing information at the local level and unlocking latent resources through social networks.

Internationally, IAD projects in the Philippines illustrate the multi-sectoral nature of this approach. These initiatives aim to accelerate growth in depressed areas, increase local participation, and distribute gains equitably. Key features of these projects include a defined geographic unit (often based on ecological zones like river basins), multi-sectoral operations (integrating infrastructure, health, and agriculture), and spatial integration that effectively links rural production areas with market towns.

2.2 Contemporary frameworks

The current literature increasingly links IAD with Sustainable Development Goals (SDGs) and climate resilience. The 2023 edition of the United Nations World Water Development Report emphasizes that building partnerships across all dimensions of sustainable development is essential for realizing human rights to water and sanitation. Furthermore, the work of Hussain and Dill (2023) positions green bonds as a vital financing instrument for these integrated projects, allowing governments to borrow from investors to fund climate-related activities and LCR (Low-Carbon and Climate-Resilient) infrastructure.

In Bangladesh, studies indicate that while the national policy has favored participatory governance, a tremendous gap remains between *de jure* policies and *de facto* practices. Bureaucratic inefficiencies, financial dependency on the central government, and political interference significantly hinder governance effectiveness at the local level. The 2023 landscape suggests that local government institutions must leverage digital platforms to improve transparency and efficiency, as governmental system digitalization serves as a mechanism for bureaucratic reform.

2.3 Legislative context in Bangladesh

The legal framework for local governance in Bangladesh is governed by several key acts. The Upazila Parishad (Amendment) Acts of 2009 and 2011 established committees for various sectors, including law and order, infrastructure, agriculture, and health. While these acts empower the Upazila Parishad to prepare five-year plans and coordinate the activities of cooperative societies, in practice, the deployment is often not integrated.

The emergence of City Corporations, governed by the City Corporation Act of 2009, adds a layer of complexity to the planning of areas like Narayanganj Sadar. City Corporations are typically more active and possess higher tax-collecting capacities than Upazilas, yet they often lack scientific approaches to engineering challenges like solid waste management.

Central to the urban development of this region is the Detailed Area Plan (DAP). The first DAP was formulated in 2010 under the Town Improvement Act 1953, primarily targeting the management of wetlands and land use zoning in the Dhaka Metropolitan region. However, the plan faced significant challenges, with nearly 22% of its protected wetlands lost to unplanned development by 2019. To address these failures, a second DAP (2022-2035) was authorized on July 6, 2022. This 2022 version is founded on three core pillars: livability, functionality, and resilience. It introduces density zoning to limit unplanned vertical growth and proposes a 547-kilometer waterway system as a "city lifeline". The 2022 DAP also attempts to shift away from colonial-era planning by advocating for guided mixed-use development and pedestrian-friendly streets.

2. Materials and Methods

This research adopts an information-based systematic approach to evaluate the operational suitability of IAD in Narayanganj Sadar Upazila. The methodology is designed to move chronologically from conceptual understanding to empirical analysis and strategic recommendation.

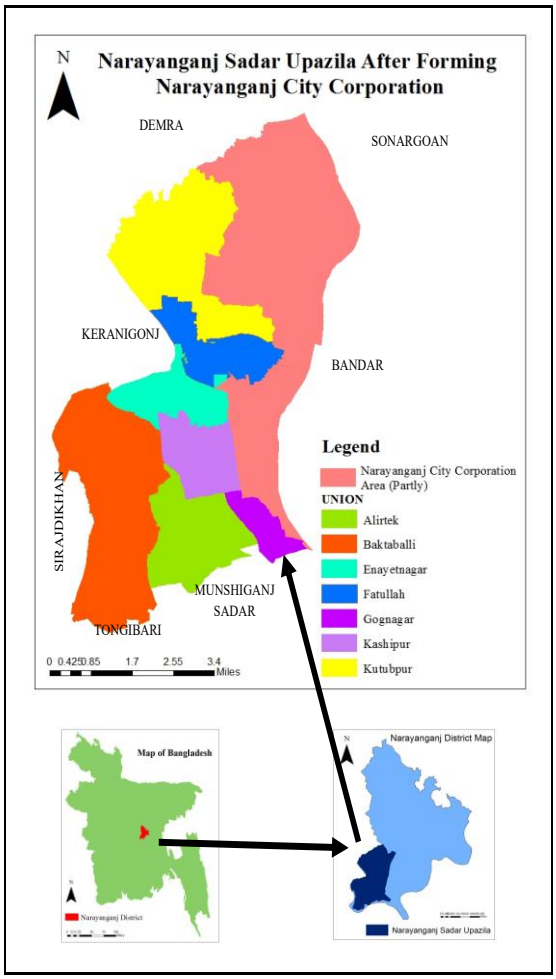

Fig 1: Map of Narayanganj Sadar

3.1 Research scoping and case study selection

Narayanganj Sadar Upazila was selected as the study area because it represents a transitional spatial unit containing both dense urban sectors and semi-rural hinterlands. Its importance is magnified by its role as an industrial powerhouse and its unique administrative status where a City Corporation, unions, and an Upazila structure overlap. To ensure a precise analysis of integration, the study focused on two clusters: the Fatullah Union and the 9 no. Ward of Narayanganj City Corporation. These adjoined areas allow for a comparative study of service activities under different administrative bodies with roughly similar population densities.

3.2 Sampling strategy and data collection

The study utilized a Two-Stage Sampling Method to collect primary data from general inhabitants. This method reduced the size of primary sampling units by first selecting clusters (Union/Ward) and then selecting specific household elements within those clusters.

Table 1: Sampling frame for general inhabitants

Unit of Analysis	Sampling Method	Population (Household)	Sample Size
Fatullah Union	Purposive / Two-Stage	206,426 (50,533)	100
9 no. Ward	Purposive / Two-Stage	27,138 (6,342)	100
Total Inhabitants			200

The sample size of 200 respondents was determined to maintain a 95% confidence level and a margin of error of ±10% for a population exceeding 20,000. In addition to inhabitants, Key Informant Interviews (KII) were conducted with officials from the Upazila Parishad, Fatullah Union Parishad, Narayanganj City Corporation, and various ward offices. Expert sampling was also employed to gather opinions from professionals in urban and regional planning.

Primary data collection included:

1. **Questionnaire surveys:** Conducted face-to-face with experts, officials, and inhabitants.
2. **Observation Surveys:** Structural observations (roads, buildings, drainage) and unstructured observations (inhabitant and official behavior).
3. **Map Collection and GIS Analysis:** Soft copy raw maps were processed using Arc

GIS 10.1 to prepare land use, location, and planning gap maps.

Secondary data was synthesized from books, journals, internet publications, and reports from government bodies like the Bangladesh Bureau of Statistics (BBS) and the Local Government Engineering Department (LGED).

3.3. Analytical techniques

The data was analyzed through a matrix of verifiable indicators.

- **Conceptual analysis:** Appraising the basis of IAD against global theoretical frameworks and 2023 finance trends.
- **Physical and Socio-Economic Exploration:** Tabulating field data to understand the status of Narayanganj Sadar.
- **Comparative Assessment:** Comparing existing spatial patterns against national planning standards (UDD, LGED, DAP 2010/2022).
- **Projection Modeling:** Utilizing compounding population growth formulas to estimate future land and service requirements for 2031.

4. Analysis of the existing socio-economic and physical conditions

Narayanganj Sadar is characterized by a multi-functional landscape where heavy industry, intense residential use, and traditional agriculture exist in close proximity.

4.1. Demographic profile and social status

The BBS 2022 Census data shows a significant population increase since 2011. The Narayanganj District population reached 3,909,138, while the City Corporation population grew to 967,951. Narayanganj Sadar Upazila now hosts 1,770,734 people.

Table 2: Updated demographic and social indicators (BBS 2022 census)

Administrative Unit	Area (sq. km)	Total Population (2022)	Density (/sq. km)	Literacy Rate (%)
Narayanganj City Corp	33.57 (land)	967,951	28,830	83.66
Narayanganj Sadar Upazila	100.74	1,770,734	17,577	80.59
Bangladesh (National)	147,570	165,158,616	1,119	74.66

The updated data reveals that literacy rates in Narayanganj (83.66%) remain significantly higher than the national average (74.66%). The average household size in Narayanganj City has decreased to 3.74, reflecting a broader trend toward smaller urban family units.

4.2. Economic characteristics

The economic vitality of the region is driven by manufacturing and services. Narayanganj Sadar contains 8,299 garment factories and 27 textile mills.

Table 3: Field of Activity and Employment Status.

Field of Activity	Male Population	Female Population	Total Engaged
Agriculture	5,439	349	5,788
Industry	43,580	27,172	70,752
Service	50,206	15,489	65,695

The employment data highlights that while the industrial sector employs the largest number of people, a significant portion of the population (especially women) is categorized under household work or is looking for work. Key Informant Interviews revealed a disconnect in the agricultural sector: while the Upazila and Union offices provide training and seeds, farmers claim that agriculture is no longer profitable due to the dominance of industries and the lack of government support in crop marketing, which allows third parties to absorb profits.

4.3. Physical land use and infrastructure status

The land use pattern in Narayanganj Sadar is heavily biased toward residential functions, covering 43% of the total area.

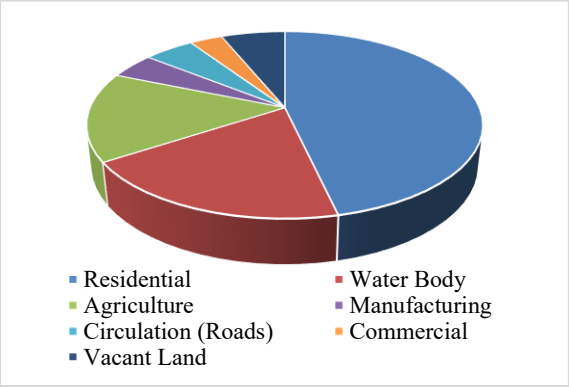

Figure 2: Land use distribution in Narayanganj Sadar.

The land use distribution for Narayanganj Sadar Upazila reveals a landscape heavily transitioned toward urbanization:

- **Residential Dominance:** Occupying 43.17 sq. km (43%), this category reflects the intense population pressure of 1.77 million people as recorded in the BBS 2022 Census.
- **Environmental Assets: Water Bodies** (18.06 sq. km, 18%) and **Agriculture** (14.38 sq. km, 14%) collectively account for 32% of the area, though agricultural land is under constant threat from industrial sprawl.
- **Economic Core:** Despite their high daily trade contribution, **Manufacturing** and **Commercial** activities occupy a relatively small spatial footprint of 4% and 3% respectively.
- **Infrastructure Deficit: Circulation (Roads)** accounts for only 4.56 sq. km (5%), which remains significantly below the 10-15% standard required for a balanced urban network.
- **Residual Potential: Vacant Land** (5.78 sq. km, 6%) represents the primary resource for future planned development and essential community facilities.

The infrastructure analysis reveals significant service disparities. In the City Corporation area, 54.3% of households use tap water, whereas in rural unions like Fatullah, 76.8% rely on tube-wells. Electricity coverage is nearly universal at 97.2%, but public satisfaction with the *continuity* of supply is low, particularly during the summer industrial peak. Solid waste management remains a critical failure; the city planning department has not allocated specific spaces for bins or containers, and management lacks scientific engineering approaches. Drainage is equally problematic, with inhabitants reporting low satisfaction due to the inadequate size and capacity of existing lines.

Housing structure data further illustrates the urban-rural divide. In the City Corporation, 39.7% of houses are permanent "pucka" structures, compared to only 27.8% in the unions. This correlates with findings on geomorphic suitability in Dhaka, where nearer distances to water bodies and weak foundation conditions increase risk sensitivity for construction.

5. Results

The evaluation of IAD as a tool at the Upazila level involves a rigorous comparison of current physical infrastructure against established national norms and standards and the updated 2022-2035 DAP guidelines.

5.1. The spatial planning gap analysis

When comparing the existing land area for services in Narayanganj Sadar against the

standards set by the Urban Development Directorate (UDD) and LGED, a massive deficit is identified across almost every category.

Table 4: Discrepancies between existing facilities and national standards

Land Use Category	Existing Area (Acre)	Required Standard (Acre)	Spatial Gap (Acre)
Residential	10,667.5	39,708.0	-29,040.5
Circulation Network	1,168.8	2,489.4	-1,320.6
Commercial Activity	731.4	1,985.4	-1,254.0
Manufacturing	1,023.0	1,985.4	-962.4
Open Space/Recreation	392.9	1,555.1	-1,162.2
Community Service	47.0	397.1	-350.1

The analysis reveals that the residential area is severely undersized for the current population, indicating extreme overcrowding and a lack of planned housing estates. The circulation network, critical for industrial transport, accounts for only 5% of land area, while standards recommend 8-15% for a balanced urban network. Furthermore, community facilities like fire stations and post offices are significantly below requirements; for instance, the study area provides only 1 post office per 55,150 people, while the DAP standard is 1 per 35,000.

The DAP 2022 guidelines provide a new yardstick for neighborhood facilities. For instance, the DAP requires one primary school per 15,000 people, but Narayanganj Sadar currently provides only one per 37,817 people. Post offices show a similar gap, with one per 55,150 people against a DAP standard of one per 35,000.

5.2. Projection and future suitability

Utilizing the population growth rate of 4.07% observed between 2001 and 2011, the population of Narayanganj Sadar is projected to reach 2,939,462 by 2031. This "population blast" will create unprecedented pressure on existing services. The Population compounding formula used for this projection is:

Where is the population of 2031, is the 2011 baseline (1,323,600), is the growth rate (4.07%), and is the 20-year interval. The actual 2022 census figure of 1.77 million suggests that this projection remains a critical threshold for land-use planning.

To meet the 2031 demand, standard area requirements would skyrocket:

- Residential land would need to expand to nearly 59,000 acres.
- Industrial and commercial land would each require over 4,400 acres.
- Educational facilities would need over 1,100 acres for primary schools and 730 acres for secondary schools.

Given that the total area of the Upazila is only about 25,000 acres, this growth is physically impossible under current horizontal development patterns. The scarcity of land will inevitably pressure the remaining 14,000 acres of agricultural land and 18,000 acres of water bodies. The growth direction of the study area, currently concentrated in the north and east, is already buffering at 3 km and could extend to 5 km by 2031, potentially devouring all vacant and restricted land.

To meet the 2031 demand, residential land would need to expand to nearly 59,000 acres. Given the total area is only about 25,000 acres, this growth is physically impossible under horizontal development patterns. The DAP 2022 aims to mitigate this by allowing higher Floor Area Ratios (FAR) in selected areas to promote vertical growth while strictly prohibiting construction on remaining agricultural land.

5.3 Strategy and growth management options

To handle this inevitable urbanization, several growth management strategies are evaluated for their suitability in Narayanganj:

1. **Densification of existing areas:** Suitable where expansion is impossible, but requires expensive vertical expansion and massive upgrades to overloaded utility services.

2. **Green belt plan:** A strip of peripheral land prohibiting development could protect the riverine environment of the Shitalakshya and Buriganga, ensuring the "loss of identity" of the town is prevented.
3. **Mixed-Use development:** Supports ACH (achieving better places to live) by collocation of activities, reducing travel demand and increasing housing options.
4. **Compact pattern:** Features high average densities and interconnection of streets. For Narayanganj, this would require an environmental planning and architectural shift to ensure a healthy, walkable urban form.

6. Discussion

The empirical findings from Narayanganj Sadar Upazila indicate that the region is currently trapped in a "vicious circle" where unchecked population growth and a critical lack of integrated spatial planning collectively drive the degradation of environmental quality and the inefficiency of public services. This is most acutely observed in the stark contradiction between the region's status as an industrial powerhouse and the diminishing agricultural resilience of its rural inhabitants. Haphazard industrial sprawl is actively eroding the secondary economic base of the local population, creating a fundamental disconnect between the manufacturing and agricultural sectors that ultimately undermines regional sustainability. The 2022 Census data confirms that while urbanization has intensified, the pressure on arable land has reached a breaking point (BBS, 2022). A potential pathway to reconcile this conflict lies in the transition to a circular bioeconomy, which, by minimizing organic waste and recovering products, could help rejuvenate natural capital (Der Ploeg et al. 2000).

A second critical implication is the "pacing problem" the systemic inability of the legal and regulatory frameworks to keep pace with the speed of technological development and disruptive urbanization. The failure of the previous DAP 2010, which was undermined by numerous amendments, underscores the necessity for the stronger institutional framework proposed in the DAP 2022 revision. Although the 2022 plan correctly emphasizes "humane" character and environmental sustainability, it is continually challenged by a rate of rapid population growth that outstrips the capacity of local authorities to provide basic services and enforce planning regulations.

Finally, the most significant barrier to the successful implementation of Integrated Area Development (IAD) is the pervasive institutional fragmentation and accountability deficit. The "merge of responsibility" among the City Corporations, Upazilas, and Union Parishads creates a situation where the lack of vertical and horizontal coordination results in the neglect of the area as a whole. This administrative overlap is compounded by structural issues in local governance, including an acute financial dependency on the central government and a persistent shortage of technical skills among administrative staff, as highlighted by contemporary studies on governance transformation in Bangladesh (Kumar, 2023). Addressing this multi-layered institutional complexity is paramount for IAD to move from a theoretical concept to an operational reality.

6. Strategic Recommendations for Practice

The operational suitability of IAD at the Upazila level in Bangladesh is possible only through a rigorous, multi-phased implementation of policy and practice.

6.1 Implementation Framework and Timeframe

The proposed IAD implementation model for Narayanganj follows a 15-year cycle, prioritizing political will and stakeholder orientation in the early years.

Table 4: Proposed Implementation Timeline

Phase	Year Range	Key Actions
Orientation	0-3	Establish political will; make preliminary decisions with

		stakeholders.
Analysis	3-7	Conduct territory analysis; identify strengths, weaknesses, and adverse effects.
Action & Follow-up	7-15	Strategic reflection on growth; develop multi-sectoral Action Plan; Full plan implementation; continual evaluation and data monitoring.

6.2 Reforming land administration and planning standards

1. Unified Standards: RAJUK, LGED, and NCC must adopt a single, population-based planning standard to resolve standard contradictions.

2. Digital Land Information System (LIS): A computerized LIS is essential for quick retrieval of cartographic information and effective land use control, potentially leveraging the existing PLIS framework (GIZ, 2023).

6.3 Strengthening the three pillars of IAD

1.Social Pillar: Implement the "School District Concept" and provide community clinics in each union to ensure decentralized health and education.

2.Physical Pillar: Promote compact urban development through vertical expansion and Transit-Oriented Development (TOD) to protect the remaining agricultural land.

3.Economic Pillar: Create exclusive, well-facilitated industrial zones while providing spatial accommodation for the informal sector near their markets to boost productivity.

6.4 Financial Diversification and Climate-Resilient Funding

Local authorities should reduce their dependency on the central government for resource mobilization. Alternative financing methods must be prioritized:

• Public-Private Partnerships (PPP): Essential for pooling financial resources and expertise to improve the delivery of basic urban services, such as waste-to-energy plants.

• Sovereign and Municipal Green Bonds: The contemporary green bond framework offers a powerful new mechanism for financing resilient, low-carbon projects (Hussain & Dill, 2023; World Bank, 2024). Following the 2023 updates, sovereign green bonds can fund LCR infrastructure, while municipal bonds can fix the corporation's liability for a long tenor, as seen in emerging South Asian models.

6.5 Institutional strengthening and digital governance

- Institutional Strengthening: A multi-stakeholder institutional setup is required to handle the "pacing problem." Local authorities must have the power to select skilled staff and manage their own budgets independently of central political interference.

- Digital Governance and Transparency: Leveraging digital platforms for e-governance can significantly improve transparency and efficiency in service delivery (GIZ, 2023). Decisions should be made through the active participation of elected representatives, ensuring that the rule of law is strictly enforced against land grabbers who fill protected water bodies.

7. Conclusion

This research concludes that Integrated Area Development (IAD) is not only operationally suitable but also critically necessary for the sustainable growth of Narayanganj Sadar Upazila. The investigation has revealed a profound spatial planning gap and institutional fragmentation that threatens the region's long-term resilience. The transition from the DAP 2010 to the DAP 2022 framework, which emphasizes livability and resilience, provides the legislative foundation for IAD. However, its success hinges on the adoption

of a multi-phased, 15-year strategic framework that integrates social, physical, and economic pillars. Key to this transition is the adoption of vertical compact growth strategies and the innovative use of green finance instruments to fund climate-resilient infrastructure.

The transition to IAD requires strong political will and the empowerment of local communities. By optimizing the ratio between potential added value and required investment for all stakeholders, Narayanganj can transform from a congested industrial hub into a resilient, dynamic, and sustainable metropolitan region.

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