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Revisiting PPP Models for Climate Resilience and Disaster Risk Reduction in Indian Local Bodies: Challenges, Opportunities, and Financial Perspectives

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Natural hazards and climate change are frequently disrupting the communities. These effects are further amplified due to anthropogenic causes and unsustainable development. More often than not, due to limited capabilities, local government is the first victim of such disruptions. In this context, Public-private partnerships (PPP) models present a unique opportunity and overcome limited government funding limitations. This study attempts to explore the potential of PPP models in supporting and financing Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR) initiatives at the local-body levels. This study reviews both the international case studies from Jamaica, Japan and Latin America and national case studies from Delhi, India's Smart City Mission. The study identifies the gaps in existing PPP frameworks and emphasises the need for innovative funding methods. The paper also discusses the importance of community engagement, multi-stakeholder engagement and traditional knowledge. Recommendations include enhancing financial resilience through blended finance, resilience bonds, and risk-sharing mechanisms. The paper proposes locally tailored PPP frameworks that prioritise long-term sustainability, capacity building, and responsive financing to foster climate-adaptive infrastructure.

Keywords: Public-Private Partnerships (PPPs), Climate Resilience, Disaster Risk Reduction (DRR), Climate Change Adaptation (CCA), Local Governance, Financing Mechanisms

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1. Introduction

India is home to several natural hazards, such as floods, droughts, earthquakes, cyclones, tsunamis etc., Due to its massive size, different geographics, climate varieties and high density of population, it is one of the most hazardous-prone countries in the world. According to the NDMA, 30% of India's land is flood-prone, amounting to an average damage of INR 5,000 crore annually (NDMA, 2008). Approximately 68% of land and 100 million in India is affected by droughts (IMD, 2018). Also, IMD records state that India suffers from an average of 5-6 cyclones annually, with the east coast of India being one of the most active zones in the world. Recent events such as Chennai Floods (2015), Kerala Floods (2018), Phailin Cyclone (2013), and Vijayawada Floods (2024) call for urgent action towards Climate change adaptation and Disaster Risk Reduction strategies at both national and local levels(NDMA, 2019).

Owing to its status as a developing nation and the principles of a welfare state, the burden of the impact is often heavy on the government. While the union and state governments have different versions/stories, it is the local bodies that become more vulnerable at times of hazards and disasters. Due to their strained financial resources and technical capability limitations, they are often defenceless. While they should be playing the role of first responders, they often end up as the primary first victims of such situations.

Due to factors such as climate change and cascading disaster risk, it is essential to strengthen the local bodies and they play the front-line role in preparedness, response and recovery. This strengthening requires a funding mechanism, which calls for innovative models such as Public-Private Partnerships (PPP) at the local-body level.

These PPP models are instruments of collaboration between the government and private entities. They come together to deliver services and infrastructure projects as required by the people. This will enable proactive/preventive measures, increase public participation, and help integrate local knowledge and resources for climate adaptation and disaster risk reduction.In the context of climate change mitigation and adaptation and disaster risk reduction, which are the pressing issues, require the attention of all levels of the stakeholders.

The funding required for planning, critical infrastructure, early warning systems, and skill and technology development can be mobilised through PPP models.

The top-down approach of planning was never suitable and will never be, given the scenario that several problems are very local and unique to specific solutions. The solution to these problems has always been local, integrated into the traditional knowledge of the people. Above all, we need more tailored or region-specific solutions with long-term adaptation goals. We need an integration of local/traditional knowledge, climate resilience and DRR into the infrastructure planning with a long-term vision. This kind of expertise and the funding for such milestones need instruments such as PPP models. In this regard, the paper discusses the possible scope for PPP at the local/regional level.

While the PPPs have shown tremendous success in energy and transportation sectors, such as the Delhi metro and expressways, we believe there is a huge untapped potential at the local body level. Resource and financial planning and policy requirements at the local level require structured research.

1.1 Research Gap

Several large-scale projects in transportation, energy, and health have been executed through PPPs. However, PPPs for DRR and CAA at the local body level remain unexplored.

- Several traditional financing instruments are quite adequate for traditional infrastructure such as roads, metro, etc. However, DRR and CCA projects are complex and evolving in nature. These projects have higher risks and require long-term financing, which is uncommon in the typical PPP approach. In this regard, there is limited research on how the risk has to be shared and the development of a long-term vision.
- The limited capacity of the local bodies and bureaucratic inefficiencies are the limitationsof the local government. There are no metrics or case studies to examine the financial and operational success of PPP models in small & medium panchayats and urban bodies. Another challenge and a research gap is how private funding can be harnessed through PPP models despite all these limitations.

These gaps require new financial models, institutional reforms and policy innovations to enable the PPP's contribution at the local body level.

1.2 Objective

The primary objective of this paper is to provide a comprehensive review of existing PPP models in India, specifically focusing on their application for Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) at the local-body level. The paper seeks to identify the gaps in current PPP frameworks, particularly in terms of financing and institutional barriers, and propose new finance-driven PPP models tailored to the specific needs of local governments in India.

2. Overview of PPP Models

In India, a few PPP models, such as Build-Operate-Transfer (BOT), Design-Build-Finance-Operate (DBFO), and Build-Own-Operate (BOO) have played a significant role in various key sectors. Some examples of such projects are: a. Transportation (Delhi Metro Rail Corporation, Quadrilateral Highway Projects), b. Energy (Ultra Mega Power Projects, Jawaharlal Nehru National Solar Missions), c. Water Management (Nagpur 24*7 water supply projects). These PPP models have been quite successful in profit-making/revenue-generating sectors. However, as discussed in the research gap, the scope and application of the PPP models in sectors with uncertain revenue, long gestation periods, and complex sharing mechanisms are yet to be researched and explored(Government of India, 2020), (ADB, 2019). Also, India has witnessed some PPP projects initiated at the local body level. For example, the Yamuna Riverfront Development Project in Delhi focussed on urban resilience and pollution. Delhi Development Authority (DDA) collaborated with private partners to create infrastructure and construct parks and green spaces to improve urban resilience and DRR. While this project successfully mitigated flood and improved amenities, it faced issues concerning real estate pressures, ecological restoration and displacement of wetlands(Delhi Development Authority, 2020). The state of Kerala, in the aftermath of the Kerala Floods (2018), initiated a Cochin Flood Management Project through the PPP model. This project primarily aimed at climate risks, such as urban flooding. This project incorporated risk-sharing mechanisms between the city government and private entities.

Under the genesis of Smart Cities Mission, Pune Smart City has also developed several key projects for battling against flood warning systems, stormwater drainage systems, green infrastructure and urban heat islands. Through this Smart City Mission, several regulatory and legal policies were enacted to promote green infrastructure and climate-resilient infrastructure. Another example is the PPP-based projects executed by Chennai Smart City for the restoration of water bodies and flood-resilient infrastructure(Ministry of Urban Development, 2015). These projects offer important lessons for implementing PPP models at the local-body level while aiming at long-term sustainability, disaster preparedness and climate adaptation. While these projects highlight the potential of PPP models, there is a need to address issues such as integration of digital technologies, early warning systems and urban planning.

2.1 Barriers to implementing PPP models for DRR and CCA

At the local body level, the implementation of PPP models requires coordination across several government agencies. The government administration, in general, especially the local body departments, works in silos, making the coordination very difficult. There is also the absence of guidelines or frameworks for the implementation of PPP projects in DRR and CCA at the local body level. The local bodies also lack the institutional structure and technical expertise to execute complex infrastructure projects through PPP models. There is a need to mandate CCA and DRR at the local bodies level, through legal and regulatory frameworks to enhance the PPP projects.

Another issue is the financial barriers regarding investment and profit sharing. As already discussed, projects in DRR and CCA have long gestation periods and limited profits. They are not revenue generation sectors such as energy or transportation. This requires expanding the scope of the Viability Gap Funding (VGF) scheme and innovative risk-sharing instruments such as resilience bonds or catastrophe bonds.

2.2 Jamaica: Hurricane Resilience Infrastructure

Jamaica is quite vulnerable to hurricanes due to its geographic location. In 2004, Hurricane Ivan devasted Jamaica, prompting the government to build climate-resilient infrastructure.

The government collaborated with the public, international financial institutions and private entities, initiating PPP models aimed at rebuilding Jamaica, especially in tourism and transportation sectors. The Jamaican government collaborated with the Caribbean Catastrophe Risk Insurance Facility (CCRIF) to cover insurance for the infrastructure and provide rapid relief funds for reconstruction in the event of any post-hurricane damage. Jamaica's National Disaster Fund was further also enhanced by the support of private entities to provide for immediate relief and recovery operations. The project had twin advantages. It boosted the economy through tourism while also paving the way for safe and hurricane-resilient infrastructure.

2.3 Japan: Sendai City's Resilience Measures

Post-2011 earthquake and tsunami, Sendai city in Japan became an example of resilience-building through PPP projects. The Sendai Framework for Disaster Risk Reduction (2015-2030) significantly promoted partnerships between governments, private sectors, NGOs, and community groups to support DRR. They initiated the construction of multi-use seawalls, early-warning systems, roads and housing using the PPP funds. Banks offered low-interest loans for the projects. This project resulted in advanced and community-centred early-warning systems.

2.4 Latin America: Multi-Country PPP Projects for Resilience

This initiative is a one-kind cross-country and cross-sectoral PPP project aimed at CCA and DRR. Through the Build-Operate-Transfer (BOT) PPP Model, the government of Peru collaborated with private sectors, to develop resilient water management systems, water reservoirs and flood barriers. Chile focussed on construction and retrofitting of critical infrastructure, bridges and hospitals.

2.5 Lessons for India: Transferable Models for DRR Financing

India could benefit from creating state-specific and local body-specific resilience funds. These funds could get pooled from private entities, national & international donors, and local & state governments. These funds could be used to respond immediately and ensure sustainable rebuilding efforts.

This could be even more beneficial for India's coastal areas, which are frequently affected by cyclones. India could also explore the green bonds and climate bonds market. In the case of Japan and Latin American countries, which have utilised green bonds to fund renewable energy and infrastructure projects. International Financial Institutions (IFIs), such as the World Bank and Asian Development Bank, could provide the required institutional backing to the bonds, thereby lowering the risk of financial investment.

Another important requirement is the need for Multi-Stakeholder Engagement. The success of several projects, their implementation, continuation and effectiveness very much depends on the engagement of all the stakeholders. Encouraging community-based organisations and establishing policies for their participation, similar to the country Chile, can ensure that PPPs align with the specific needs of the local communities.

There are several diverse approaches to integrating the PPPs in DRR and CCA. Adopting innovative financial models, developing resilience-building frameworks, and ensuring the bottom-up approach in governance models can enhance climate resilience. For India's climate and disaster landscape, these adaptable lessons offer a pathway to reinforcing the role of local governance in resilient infrastructure development.

3. Financing and Budgeting Mechanism in Public Private Partnerships for Disaster Risk Reduction and Climate Change Adaptation

The collaboration of Public-Private Partnerships in Disaster Risk Reduction and Climate Change Adaptation has gathered commendable endorsement owing to the increasing disasters caused by climatic changes. Local bodies in India that are responsible for urban and rural developments have begun to look for cooler ways of bringing in expertise through PPPs and enhancing climate resilience. This article addresses the issues of financing and budgeting in the public-private sector for DRR and CCA PPPs.

In particular, it discusses structural innovations, challenges of implementation and possible remedies, and uses diagrams for illustrative purposes.

Financing Structures

3.1 Innovative Financing Mechanisms

Blended Finance: In relation to DRR strategies blending finance is to pool together public and private monetary sources to create a more robust approach to climate change response strategies that are more likely to succeed. It may involve such usage of government or philanthropic resources in risk-bearing that would entice private investment.

Resilience Bonds: Resilience bonds are a recently created further financial instrument developed for the purpose of capital raising based on climate resilience criteria. Investors are paid on returns that are tied up with measurable targets linked to lessened recovery after disasters such as financial costs in assisting disaster victims to rebuild. This type of model for investment performance enhances efficiency and accountability.

Public-Sector Guarantees: When providing incentives to private investors in PPPs, the government may offer guarantees to further reduce the perceived risk. These guarantees are related to revenue loss or operational threats, which make private investment in crucial DRR projects more attractive.

3.2 Risk Distribution Among Stakeholders

The governance of risk within the framework of a DRR-sensitivity PPP financing model can be explained by the notion that such risk is shared between multiple parties:

1. Public Sector: Undertakes regulatory and policy risks, offers guarantees, and also frequently mops up the pre-financing losses incurred in project preparation.
2. Private Sector: Commits to certain operational and financial risks, as in such cases, they provide service or infrastructure with returns on investment in sight.
3. Multilateral Institutions: Help with funding and provide technical assistance services, helping manage the difficulties that come with international financing of projects and offering design capabilities for the project.

Table 1: Summary of Financing Mechanisms

Financing Mechanism	Description	Pros	Cons
Blended Finance	Combines public and private funds to leverage resources	Reduces risk for private investors	Complexity in structuring deals
Resilience Bonds	Performance-based bonds for funding resilience initiatives	Incentivizes measurable outcomes	Requires robust monitoring frameworks
Public-Sector Guarantees	Guarantees to cover revenue or operational shortfalls	Attracts private investment	Government budget constraints
Risk-Pooling Mechanisms	Shared risk frameworks among stakeholders	Spreads risk, encourages collaboration	May dilute accountability

3.3 Challenges in the Funding of Public Private Partnership

3.3.1 Financial Risks of The Stakeholders

a. Private Investors: Private investors generally face high risk exposure when investing in private equity such as:
i. Long-Term Viability: The uncertainty of whether or not projects will be able to withstand changing climate dynamics can influence investment levels.
ii. Investment Climate: Some challenges that may be faced in achieving a certain return on investment such may include changing favorable investment climate.
b. Local Governments: Local governments may have:
i. Financial Cap: Such limited financial capacity may be a hindrance towards their deft participation in PPPs.
ii. Capacity Problems: When stakeholders do not possess enough skills to handle complex forms of PPP, the end result is a loss in the efficiency of project execution.

3.3.2 Remedies to Address Financial Challenges

1. Contingent Funding: The use of contingent funding mechanisms means that funds can only be released when certain triggering circumstances take place (e.g. a disaster occurs). This helps to limit the initial cost burdens of local governments at the same time, protecting the private investors.
2. Risk-Pooling Mechanisms: The establishment of risk-pooling frameworks may provide the opportunity to share risk amongst several actors and thus potential financial exposure is diffused and encourages risk-sharing strategies to DRR.

Such mechanisms should also improve the bankability of projects and reduce the barriers to investment.

3.4 Opportunities for Improvement

1. Enhancing Stakeholder Collaboration: Improved cooperation amongst the stakeholders, including local communities, non-government organisation and private investors should improve risk analysis and project design that is more relevant to the community.

2. Capacity Building: Optimum capacity building effort on the local agencies investing across different projects help them structure and manage effectively PPP and enhance project delivery and increase the confidence of investors.

3. Regulatory Frameworks: The formulation of appropriate regulatory frameworks which clearly defines the various roles, responsibilities and processes in the implementation of PPPs can help to reduce uncertainty and increase the involvement of the private sector.

Best Practices and Case Studies: The analysis of various case studies of PPPs within the framework of DRR and CCA can help derive some important lessons, demonstrating how different financing modalities have been used effectively. Looking back at the climate resilient and disaster risk reduction PPP models in local bodies in India is fraught with difficulties and offers opportunities to overcome them. The advancement of stakeholders' infrastructural requirements within communities can be achieved through innovative financial mechanisms, risk transfer and collaboration. The successful application of PPPs within national DRR strategies enables not only improvement of the particular infrastructure and services but also the emergence of a preparedness and climate resilient society.

4. Conclusions

To conclude the paper, it can be seen that the engagement of Public-Private Partnerships into disaster risk reduction and climate change adaptation provides a tremendous opportunity to meet the financial, operational and infrastructural requirements of local bodies in India. Nonetheless, there are challenges, including coordination, financial sustainability and regulatory frameworks. Inconveniences aside, the scope of benefits, as the examples from both domestic and foreign experiences suggest, makes the model worthwhile.

To enhance the application of PPPs in this domain, some of the approaches include the creation of financing mechanisms such as resilience bonds, fostering multi-stakeholder participation to improve project design and implementation and supporting local bodies through capacity building activities. These initiatives can ensure that PPPs address current DRR requirements while achieving longer term climate change adaptation objectives. In this respect, through these approaches, India will be in a position to increase its readiness and resilience to climate threats and thus eventually create more secure populations.

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