



## Smart Villages as Technology Hubs for Welfare

Smart villages integrate digital infrastructure, institutional reform, and community participation to extend inclusive development beyond urban centres. Using India's digital public goods—BharatNet, CSCs, DBT, eSanjeevani, e-NAM, and MPACS—the model emphasises convergence over connectivity. The country's greater success depends on interoperability, local capacity, and accountable execution within a rights-based governance framework.

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India's development trajectory is intensely intertwined with the transformation of its villages. About 870 million (63 per cent) of India's population are rural and are distributed across 2.70 lakh Gram Panchayats covering 6.5 lakh villages. Agriculture employs close to 45 per cent of the national workforce, and yet welfare delivery

at the village level has remained leaky, slow, and unaccountable for decades.

### Understanding Smart Village

The Smart Cities Mission was a necessary intervention for urban rejuvenation. While urbanisation has often been viewed as the primary engine of economic growth, the idea of smart villages has emerged as an

equally compelling concept. Unlike a narrow focus on infrastructure development, smart villages represent a holistic approach to rural development, where technology would generate development momentum by serving as a catalyst for improving quality of life, enhancing livelihood opportunities and ensuring equitable access to essential services. The idea of smart villages aims to reduce rural-urban disparities in the access to healthcare, education, credit and governance.

Rapid advancements in digital technologies offer unparalleled opportunities for rural areas to address age-old development constraints. When a village is equipped with sustained digital connectivity, renewable energy, knowledge access, and institutional capacities, it evolves into a decentralised technology hub capable of delivering efficient and equitable welfare services.

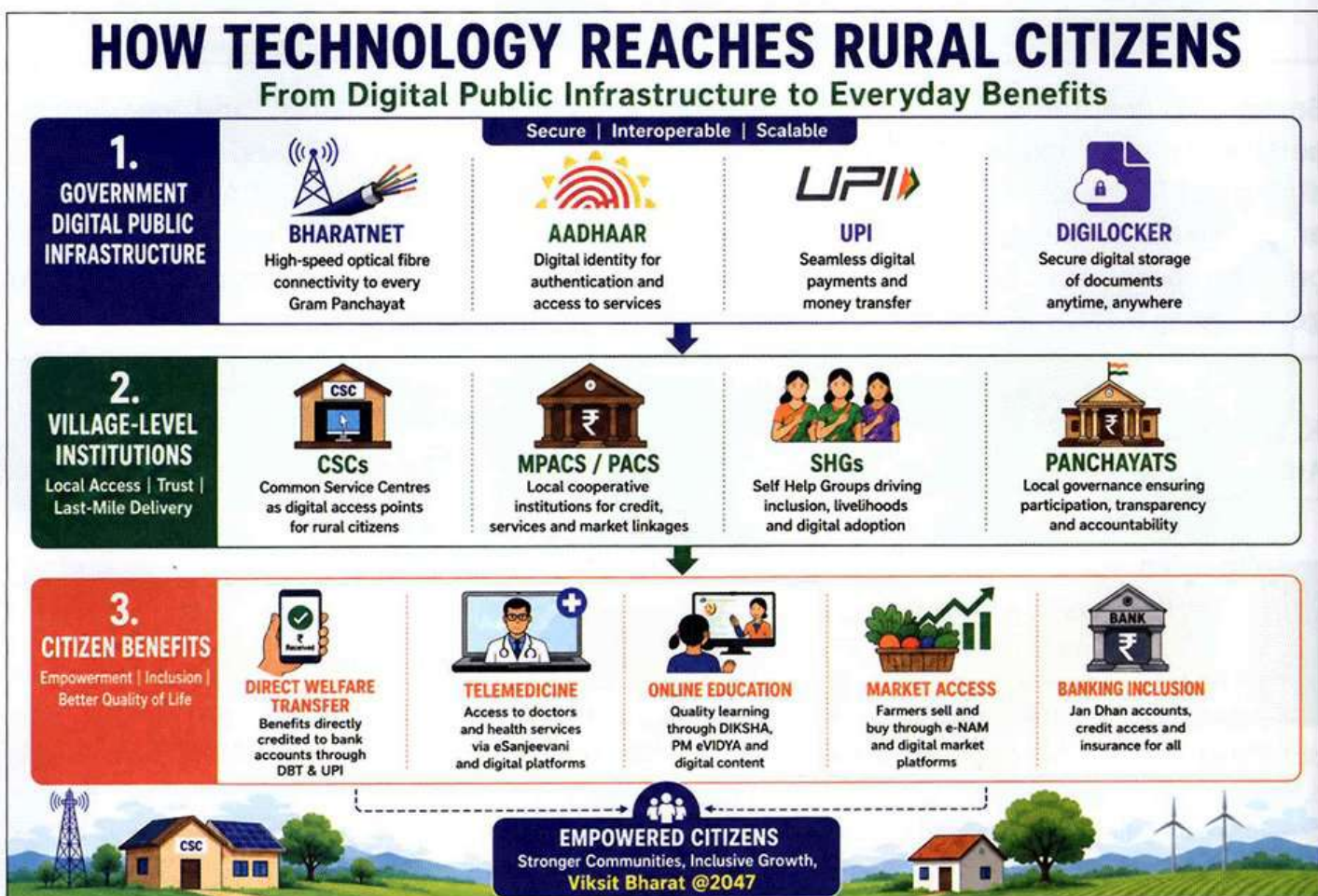
### Architecture of a Smart Village

The conceptual architecture of a smart village rests on sustainability, inclusiveness and technological enablement. It is built on interconnected pillars – reliable digital connectivity, clean and affordable energy, robust knowledge infrastructure, and a local economic ecosystem capable of absorbing and

sustaining technological innovation. These pillars align closely with the Sustainable Development Goals framework, which emphasises that lasting transformation depends on convergence across sectors. A smart village is defined not merely by connectivity, but by human agency. Welfare gains emerge when communities possess the institutional capacity to utilise digital tools for governance, healthcare, education, market access, and grievance redressal. This indicates community participation and decentralised governance are foundational for making a village smart. Technology serves as an enabler, while the smart village model strengthens local institutions alongside digital infrastructure, thereby deepening the democratic promise of the 73rd Constitutional Amendment.

### Policy Ecosystem in India

India has made significant progress in building a policy architecture that supports the emergence of smart villages as technological hubs. Flagship schemes like Digital India have laid the foundation for rural digital transformation by promoting connectivity, digital literacy, and e-governance. BharatNet has transformed rural connectivity. It has connected over 2.14 lakh Gram



**Table 1: Smart Village: Domain-wise Transformative Benefits**

| Domain                        | Transformative Benefit   |
|-------------------------------|--|
| <b>Digital Infrastructure</b> | <ul style="list-style-type: none"> <li>Reliable internet connectivity and mobile penetration form the backbone of smart villages.</li> <li>Institutions such as Common Service Centres (CSCs) act as local access points, enabling citizens to avail digital services ranging from documentation to financial transactions.</li> </ul>   |
| <b>E-Governance</b>           | <ul style="list-style-type: none"> <li>Technology enables seamless delivery of welfare schemes through digital platforms.</li> <li>Direct Benefit Transfer (DBT) mechanisms reduce leakages, enhance transparency, and ensure timely support to beneficiaries.</li> </ul>  |
| <b>Healthcare</b>             | <ul style="list-style-type: none"> <li>The use of telemedicine has the potential to revolutionise rural healthcare by connecting patients with doctors in urban centres.</li> <li>Digital health records and remote diagnostics further improve efficiency and accessibility.</li> </ul>   |
| <b>Education</b>              | <ul style="list-style-type: none"> <li>Smart villages facilitate access to online learning resources, digital classrooms, and skill development platforms.</li> <li>This helps bridge the educational divide and equips rural youth with capabilities relevant to the modern economy.</li> </ul>   |
| <b>Livelihoods/ Income</b>    | <ul style="list-style-type: none"> <li>Technology-driven platforms such as e-NAM provide farmers with access to market information, better price discovery, and broader market linkages.</li> <li>Precision agriculture, weather forecasting, and digital advisory services further enhance productivity and resilience.</li> <li>The PM Vishwakarma Scheme of Ministry of MSME, the Government of India has enhanced rural self-employment through digital interventions such as CSC-based enrolment, Aadhaar-enabled verification, online registration, e-vouchers for toolkits worth ₹15,000, digital loan processing, and incentives for adopting digital payments.</li> </ul> |

Panchayats through 6.93 lakh kilometres of optical fibre, supporting 12.81 lakh Fibre-to-the-Home connections and 1.04 lakh Wi-Fi hotspots by 2025. Rural internet users increased from 115 million in 2015-16 to over 405 million by September 2024, while data costs dropped from Rs. 269 per GB in 2014 to approximately Rs. 8-10 per GB by 2025. The National Broadband Mission 2.0, launched in January 2025, further reinforces this digital trajectory.

Infrastructure development has been further strengthened through programmes like Pradhan Mantri Gram Sadak Yojana and the Saubhagya scheme for rural electrification ensuring physical connectivity and reliable electricity both critical for technology deployment and adoption. The National Rural Livelihoods Mission simultaneously builds the institutional capacity at the community level that technology adoption requires. The Ministry of Electronics and Information Technology and the Ministry of Rural Development are the primary institutional drivers in promoting convergence across

schemes. The emergence of Digital Public Infrastructure encompassing Aadhaar, Unified Payments Interface, and DigiLocker further enabled efficient, transparent and became the backbone of targeted delivery of welfare benefits. Convergence of schemes became an operational imperative where a beneficiary accesses credit through a Primary Agricultural Credit Society (PACS), receives wages through a Jan Dhan account, consults a doctor via eSanjeevani, and sells produce on National Agriculture Market (e-NAM).

### Smart Villages as Technology Hubs

The emergence of smart villages as decentralised technology hubs can be examined through five interconnected sub-systems/domains (Table 1). Together, these components create an integrated ecosystem where technology acts as a multiplier of welfare outcomes. The transformation of villages into technology hubs involves the integration of multiple domains:



## Turning Farmers into Solar Entrepreneurs – A Success Story from Gujarat



In 2016, a small village in Gujarat introduced a groundbreaking idea that transformed local farmers into renewable-energy entrepreneurs. The Dhundi Solar Energy Producers' Cooperative Society (DSEPCS), supported by the International Water Management Institute (IWMI), became the world's first solar irrigation cooperative. The initiative aimed to address two major rural challenges: unreliable electricity for irrigation and rising farming costs. This brought in rural tech-enabled solar innovation.

Most farmers in the region were small landholders who could not independently afford solar infrastructure. By forming a cooperative, they pooled resources to install six solar pumps with a combined capacity of 56.4 kWp. The cooperative signed a 25-year Power Purchase Agreement (PPA) with Madhya Gujarat Vij Company Limited (MGVCL), allowing members to sell surplus electricity to the grid at a fixed rate. This facilitated establishment of a collaborative clean-energy infrastructure.

The project created a dual-income model: farmers used solar power for irrigation while earning additional revenue through energy sales. It also reduced dependence on diesel pumps, lowered operational costs, and ensured a more reliable daytime power supply. Initially, farmers were hesitant due to high installation costs and unfamiliarity with solar technology. However, training, pilot demonstrations, and institutional support gradually built confidence. This indicated that smart energy, collective efforts can ensure sustainable income.

Innovation has driven transformation in Dhundi. The Dhundi model highlights how cooperative structures, technological innovation, and strategic partnerships can create sustainable rural business ecosystems while contributing to clean energy goals.

CSCs have institutionalised last-mile digital access, with 5.34 lakh centres operational by April 2025, including 4.17 lakh in rural India. These centres deliver Aadhaar, banking, insurance, crop insurance, and e-governance services. The DBT architecture, powered by the JAM trinity, expanded beneficiary coverage from 11 crore in 2013 to 176 crore in 2024, generating cumulative savings of Rs. 3.48 lakh crore. Under Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), 98 per cent of wages are transferred on time, while DBT accountability has saved Rs. 42,534 crores. The Public Distribution System alone recorded savings of Rs. 1.85 lakh crore through technology-enabled targeting.

In rural healthcare, the eSanjeevani under Ayushman Bharat linked 1.76 lakh Ayushman Arogya Mandirs with district and tertiary hospitals, facilitating nearly 372 million teleconsultations by mid-2025, through over 2.30 lakh providers. Women account for more than 57 per cent of users, indicating reduced mobility barriers in rural healthcare access. Educational digital platforms like Digital Infrastructure for Knowledge Sharing (DIKSHA) and PM eVIDYA, alongside Pradhan Mantri Gramin Digital Saksharta Abhiyan, have expanded digital learning with Pradhan Mantri Gramin Digital Saksharta Abhiyan training 6.39 crore rural citizens by March 2024. Meanwhile, e-NAM integrated 1,389 mandis and registered 1.78 crore

farmers and 2.62 lakh traders, with trade volumes rising from Rs. 34,940 crores in 2019-20 to Rs. 78,424 crores in 2023-24.

### Cooperatives and Community Institutions

Primary Agricultural Credit Societies (PACS), serving over 16 crore farmer-members are critical intermediaries between digital infrastructure and rural adoption. Beyond credit delivery, they increasingly function as agricultural aggregators, and digital service centres. Their transformation into Multipurpose PACS (MPACS), enabled by revised model bye-laws permitting over 25 business activities, marks a major cooperative sector reform. Under the *Sahkar se Samridhhi* vision, the Government targets 2 lakh multipurpose cooperatives at the panchayat level by 2027. By April 2025, 19,619 MPACS had been registered, while 31 States and UTs have adopted the model bye-laws. Simultaneously, 67,930 PACS across 30 States and UTs have been approved for computerisation with Rs. 865.81 crore in support. Integrated into the Cooperative Stack ecosystem, PACS are evolving into decentralised, community-owned technology hubs delivering DBT services, Banking, and telemedicine, backed by deep reservoirs of local trust. A case in point is ensuring smart energy solutions for community development through cooperation.

### Challenges and Constraints

Despite notable progress, smart villages continue to face major constraints. The digital divide – across gender, geography, age, caste, and income, remains significant. Rural women are particularly disadvantaged by low smartphone ownership, limited digital literacy, mobility restrictions and gendered social norms. Only 38 per cent of Indian households are considered digitally literate. Pratham's Annual Status of Education Report (ASER) findings highlight a persistent digital gender divide in rural India, where girls continue to lag behind boys in smartphone ownership, digital access, and online skills. The report found that only 26.9 per cent of girls owned smartphones compared to 36.2 per cent of boys, reflecting unequal access to digital opportunities and learning resources.

BharatNet also faces persistent last-mile connectivity and maintenance challenges while fragmented welfare architecture requires citizens to navigate multiple portals and grievance systems for schemes viz. Pradhan Mantri Kisan Samman Nidhi, Pradhan Mantri Fasal Bima Yojana and MGNREGS. At the same time, rural data

privacy frameworks remain underdeveloped, and the financial sustainability of CSCs in low-demand areas continues to require policy support.

Addressing these challenges requires a multi-pronged coordinated investment in infrastructure, institutional reform, and community empowerment. National Broadband Mission 2.0 provides a renewed institutional framework, but success will depend on reliable connectivity, improved service quality in remote regions, and satellite solutions where fibre deployment is unviable. Digital literacy should be prioritised alongside infrastructure. ASHAs, anganwadi workers, Self-Help Group (SHG) leaders, and PACS can serve as effective last-mile digital facilitators when supported with appropriate remuneration and training.

### The Way Ahead

Scheme convergence must become operational rather than aspirational. The MPACS model bye-laws provide a framework for integrating credit, inputs, digital services, and market access within community institutions. The PM Dhan-Dhaanya Krishi Yojana, and Agri-Stack with the MPACS reflects this shift. Public-private-community partnerships in agri-tech, ed-tech, and digital health, supported by open platforms like Open Network for Digital Commerce and Ayushman Bharat Digital Mission, can further deepen rural innovation. Within the *Viksit Bharat@2047* vision, smart villages are not ancillary to development.

The smart village idea seeks to ensure that the benefits of the digital economy – good governance, education, healthcare, market access, and financial inclusion extend equitably beyond urban India. Over the past decade, India has created a substantial policy ecosystem through BharatNet, CSCs, DBT, eSanjeevani, e-NAM and MPACS framework. The central challenge now is convergence, ensuring these systems work together in tandem seamlessly at the village level. Former President of India APJ Abdul Kalam's Provision of Urban Amenities in Rural Areas vision recognised that isolated connectivity cannot create sustainable development ecosystems. Smart villages, built on community participation, digital public infrastructure, and trusted local institutions viz. MPACS and SHGs, offer a practical pathway towards national progress. If effectively implemented, smart villages can not only bridge the rural-urban divide but also position rural India as a key driver of *Viksit Bharat*. □

