



Grassroots innovation, local knowledge, and the sociology of community-led development

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Abstract

Grassroots innovation has emerged as an important alternative framework within contemporary development discourse, particularly in societies marked by structural inequality and uneven technological access. Unlike formal innovation systems dominated by corporations, state institutions, and market-driven research, grassroots innovations emerge from everyday experiences, local knowledge systems, and community-based problem-solving practices. The objective of this paper is to critically examine sociological significance and challenges of grassroots innovations in India. It also argues that grassroots innovations represent not merely technical interventions but alternative modes of knowledge production and social transformation. The study further examines how grassroots innovations challenge dominant epistemologies, empower local communities, and contribute toward sustainable and inclusive development. In addition, cinematic representations of grassroots innovation are discussed to understand how popular culture constructs narratives around local creativity, self-reliance, and community agency. The paper concludes that mainstreaming grassroots innovation requires structural transformation in policy, institutional recognition, financial accessibility, and epistemic justice. Sustainable development cannot be achieved through top-down technological models alone, rather, it requires the integration of localized, participatory, and community-driven systems of innovation. Keywords: Grassroots Innovation, Traditional Knowledge, Community Development, Inclusive Innovation, Sustainable Development, Informal Sector

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Introduction

Grassroots innovation refers to science and technological development emerging from communities and ordinary individuals who seek practical solutions to everyday social, economic, and environmental problems. These innovations are generally low-cost, context-specific, and rooted in local realities. Unlike mainstream innovations that are largely produced within formal institutions such as corporations, universities, or state-funded laboratories, grassroots innovations emerge from lived experiences and local knowledge systems. They are shaped by necessity, empathy, social responsibility, and collective survival rather than profit maximization or market expansion (Gupta, 1996; Seyfang & Smith, 2007; Rajan, 2012) [13, 24, 28]. From a sociological perspective, grassroots innovation challenges dominant assumptions about who can innovate and what qualifies as legitimate innovation. Conventional innovation systems are generally centralized, technocratic, and capital-intensive. They privilege formal scientific knowledge, institutional expertise, and measurable economic outputs. Grassroots innovation disrupts this framework by foregrounding situated knowledge and experiential learning. It recognizes marginalized communities not as passive recipients of development but as active producers of knowledge and technology. Grassroots innovations are embedded within broader social relations, cultural norms, ecological conditions, and power structures. Their emergence often reflects structural failures where state institutions and market systems fail to address local needs. Communities develop adaptive technologies and practices to survive conditions of exclusion, poverty, environmental degradation, or infrastructural neglect. Therefore, grassroots innovation is not simply a technical process but also a social

and political process through which communities negotiate survival, autonomy, and dignity. The importance of grassroots innovation has grown significantly in recent decades due to increasing concerns about sustainable development, ecological crises, poverty alleviation, and inclusive growth. In countries such as India, where large sections of the population continue to remain excluded from formal innovation systems, grassroots innovation provides an alternative developmental pathway rooted in local capacities and collective agency.

Methodology

This study adopts a qualitative and interpretive research methodology to critically examine the sociological dimensions of grassroots innovation and traditional knowledge practices in India. The research is primarily exploratory and analytical in nature, focusing on understanding how grassroots innovations emerge, function, and interact with broader structures of development, power, sustainability, and social exclusion. Since grassroots innovation is deeply embedded within social relations, cultural contexts, and lived experiences, a qualitative approach is more appropriate than a purely quantitative framework. The study relies extensively on secondary sources of data, including academic journal articles, books, policy reports, institutional publications, documentary evidence, and case studies related to grassroots innovation, informal sector innovation, sustainable development, and community-based technological practices.

In addition to that, the study also uses illustrative case-based interpretation drawn from cinematic representations such as *Swades*, *3 Idiots*, *Padman*, and *The Boy Who Harnessed the Wind* to examine how grassroots innovation is culturally

represented and socially imagined within popular discourse. These films are treated not merely as entertainment texts but as socio-cultural narratives that reflect broader themes of self-reliance, localized problem-solving, and community agency. The methodology also incorporates a critical sociological perspective to analyze the structural challenges faced by grassroots innovators, including financial exclusion, institutional barriers, weak diffusion mechanisms, and epistemic marginalization. Rather than treating innovation as a purely technological phenomenon, the study approaches it as a socially embedded process connected to issues of inequality, sustainability, governance, and participatory development. The analysis therefore combines descriptive, interpretive, and critical approaches to understand grassroots innovation as both a developmental practice and a form of resistance against centralized and market-dominated innovation systems. By synthesizing theoretical insights, empirical illustrations, and sociological interpretation, the study attempts to provide a comprehensive understanding of how grassroots innovation contributes toward inclusive development and alternative models of social transformation.

Historical Evolution of Grassroots Innovation in India

The roots of grassroots innovation in India can be traced back to the anti-colonial struggle and Gandhian philosophy of self-reliance. Mahatma Gandhi emphasized decentralized production, village industries, and local technologies as essential components of Gram Swaraj or village self-governance. The spinning wheel, or Charkha, symbolized not only economic self-reliance but also resistance against colonial industrial systems (Abrol, 2004) ^[1]. Gandhian thought therefore laid the ideological foundation for localized and community-centered innovation practices. In the early 1990s, Dr. Anil Gupta significantly expanded the discourse on grassroots innovation through his work on traditional knowledge systems and the “knowledge-rich poor.” Gupta challenged the dominant perception that innovation belongs only to scientifically trained experts or technologically advanced institutions. Through the establishment of the Honey Bee Network, he emphasized the need to identify, document, protect, and support innovations developed by ordinary individuals and local communities (Gupta, 1996; Cozzens & Sutz, 2012) ^[7, 13].

The emergence of grassroots innovation must also be understood within the broader history of the informal sector. During the 1960s, the International Labour Organization conceptualized the informal sector as a temporary residue of underdevelopment expected to disappear with modernization and industrial expansion (Guha-Khasnobis *et al.*, 2006) ^[12]. This reflected the modernization paradigm, which assumed that formalization represented the inevitable endpoint of development. However, informality persisted and expanded, revealing that it was structurally embedded within capitalist economies rather than existing outside them (Amin, 2002; Chen, 2007) ^[3, 6]. This historical misunderstanding contributed to the neglect of informal innovations for decades. Since the informal sector itself was treated as economically insignificant, the knowledge produced within it was similarly dismissed. Yet informal communities continuously generated context-specific innovations that enabled survival under conditions of scarcity and exclusion.

The appropriate technology movement of the 1970s further contributed to the development of grassroots innovation discourse. This movement argued that technologies should be locally adaptable, resource-efficient, and aligned with community needs rather than based on capital-intensive industrial models (Darrow & Pam, 1978; Abrol, 2005) ^[2, 9]. However, the rise of neoliberal economic policies during the 1980s marginalized such approaches and re-established the dominance of large-scale industrial technologies. Contemporary grassroots innovation therefore represents the continuation of a long-standing alternative technological paradigm rooted in local autonomy, sustainability, and decentralized knowledge production.

Global Dimensions of Informal and Grassroots Innovation

Grassroots and informal innovations are not confined to India. Similar forms of community-based innovation exist across different societies, though they are shaped by distinct cultural and socio-economic contexts. In Kenya, the “Jua Kali” sector reflects artisanal production systems operating with minimal formal regulation (Daniels, 2010) ^[8]. In China, “Zizhu Chuangxin” emphasizes decentralized creativity and local improvisation (Hua *et al.*, 2010; Radjou *et al.*, 2012) ^[18, 23]. Brazil’s “Gambiarra” represents innovation through improvisation under material constraints, while France’s “Système D” highlights resourceful problem-solving practices (Radjou *et al.*, 2012) ^[23]. Even in advanced industrial economies such as the United States and the United Kingdom, forms of grassroots innovation exist through do-it-yourself cultures, community energy initiatives, recycling systems, and local sustainability movements (Whalley, 1991; Smith *et al.*, 2014) ^[29, 30].

These global examples demonstrate that grassroots innovation emerges as a universal adaptive mechanism under conditions of exclusion, scarcity, or institutional failure. What differs across societies is not the process itself but the cultural framing and recognition attached to such innovations. At the same time, there is a tendency to romanticize grassroots innovations as purely creative and resilient responses. Such interpretations remain incomplete. These innovations indeed demonstrate creativity, but they also reflect structural inequality, institutional neglect, and developmental exclusion. Communities innovate because they are compelled to survive within systems that systematically deny them resources, infrastructure, and institutional support. Therefore, grassroots innovation must be understood simultaneously as a form of creativity and as evidence of structural failure.

Sociological Importance of Grassroots Innovation and the Politics of Everyday Survival

Grassroots innovation represents a structurally significant process through which marginalized communities respond to uneven development and social exclusion. Unlike formal innovation systems driven by market logic and institutional power, grassroots innovation emerges directly from lived realities. This makes it highly responsive to localized problems. Grassroots innovations contribute significantly to poverty alleviation, socio-economic development, and inclusive growth in developing societies (Gupta, 1996; Davies, 2012^[13, 15]; Gupta, 2013). These innovations are designed around actual community needs rather than standardized market demands. Agricultural tools such as

onion transplanters, low-cost plowing machines, and irrigation devices are examples of technologies created to address local farming conditions, labor shortages, and financial constraints. Similarly, low-cost sanitary napkin machines, mobility devices for differently-abled individuals, and localized healthcare practices directly intervene in everyday issues related to health, accessibility, and dignity.

Ecological Knowledge, Sustainability, and Local Adaptation

One of the most important dimensions of grassroots innovation is sustainability. Unlike industrial production systems dependent on large-scale extraction and consumption, grassroots innovations often operate within ecological limits. They frequently utilize recycled, locally available, or renewable materials. This ecological orientation is not always driven by formal environmental consciousness but by material necessity and scarcity. Communities develop systems of reuse, repair, and adaptation because resource efficiency becomes essential for survival. Grassroots innovation therefore reflects an alternative ecological rationality where sustainability is embedded within everyday practices rather than imposed externally through policy frameworks.

Community Agency, Participation, and Social Transformation

Grassroots innovation also contributes to community empowerment by transforming marginalized populations from passive recipients into active problem-solvers. From a sociological perspective, this process enhances social agency. Women's self-help groups involved in sanitary napkin production, for example, not only address menstrual health issues but also create opportunities for economic independence, collective organization, and social participation. Grassroots innovation therefore operates simultaneously at economic, social, cultural, and political levels. It strengthens local capacities while reducing dependency on external institutions.

Grassroots Innovation as an Alternative Social Order

Grassroots innovation represents an alternative social order that emerges from the margins of formal economic and institutional systems. Unlike mainstream innovation models that are dependent on capital-intensive production, technological infrastructure, and formal expertise, grassroots innovations are deeply rooted in local social relations, cultural values, and everyday survival strategies. They emerge within contexts where communities experience exclusion from state support, market access, and institutional resources. In such situations, innovation becomes a collective response to structural inequalities rather than merely an economic activity. Grassroots innovations therefore challenge dominant assumptions that innovation belongs only to corporations, laboratories, or scientifically trained experts. Instead, they redefine innovation as a socially embedded process generated through lived experiences, local experimentation, and community participation.

From a sociological perspective, grassroots innovations operate through a fundamentally different logic when compared to mainstream capitalist innovation systems. Formal innovation systems are generally organized around profit maximization, market expansion, intellectual property

rights, and technological standardization. Grassroots innovation, in contrast, is shaped by necessity, empathy, cooperation, and collective well-being. These innovations are generally low-cost, adaptable, and context-specific because they are designed by individuals who directly experience the problems they seek to solve. Their significance lies not only in technical efficiency but also in their ability to generate social inclusion and local empowerment. This alternative innovation model reflects what may be called a moral economy of innovation, where social responsibility and community survival become more important than commercialization. The characteristics of grassroots innovation further reveal its sociological significance. First, grassroots innovation is fundamentally pro-poor in orientation because it directly addresses the needs of marginalized communities excluded from mainstream development processes. Since innovators often belong to these communities themselves, the solutions they create are grounded in experiential realities rather than external assumptions. Second, these innovations are highly cost-efficient and frugal. Operating under conditions of scarcity compels communities to maximize utility while minimizing expenditure. However, this frugality should not be interpreted as technological inferiority. Instead, it represents alternative production logic where accessibility and sustainability are prioritized over scale and profit. Another defining feature of grassroots innovation is that it is empathy-driven and necessity-based. Innovators are frequently motivated by collective responsibility and a desire to improve local conditions rather than by personal financial gain. Such innovations therefore emerge from social obligations, mutual care, and everyday struggles. In many cases, communities innovate because institutional systems have failed to provide accessible solutions. Necessity thus becomes both the trigger and continuing condition shaping grassroots innovation processes. These innovations evolve gradually through experimentation, adaptation, and collective learning. Grassroots innovation is also deeply community-centered. Knowledge production occurs through informal social interactions, collaborative practices, and collective participation rather than through formalized institutional mechanisms. This directly challenges dominant epistemological systems that privilege codified scientific knowledge over experiential and situated forms of understanding. Many grassroots innovations survive because communities create protected social spaces where experimentation can occur outside the pressures of market competition and institutional regulation. These spaces are sustained through social trust, reciprocal exchange, and collective ownership. Furthermore, grassroots innovation frequently functions as a form of resistance against dominant technological and developmental paradigms. By emphasizing local sustainability, ethical production, ecological balance, and social cooperation, these innovations propose alternative ways of organizing economic and social life. Community energy systems, local recycling initiatives, organic farming networks, and decentralized water management projects demonstrate that sustainability and inclusivity are not abstract developmental goals but practical possibilities rooted in local social realities. In this sense, grassroots innovation is not simply about producing technologies. It is about constructing alternative social futures grounded in participation, autonomy, and collective well-being.

Cultural Representations of Grassroots Innovation in Cinema

Cinema often functions as a cultural medium through which grassroots innovation becomes visible and socially recognizable. Films represent innovation not merely as technical achievement but as a social process rooted in local realities.

Swades and Community-Based Innovation

In the film *Swades*, the protagonist Mohan Bhargava collaborates with villagers to create a small-scale hydroelectric project using local water resources. The innovation is simple, context-specific, and community-driven. The film highlights how technological solutions become meaningful only when they emerge from an understanding of local social realities.

3 Idiots and Informal Creativity

The film *3 Idiots* presents innovation as a process of practical problem-solving rather than formal academic achievement. Rancho's low-cost inventions resemble actual grassroots innovations documented by institutions such as the Honey Bee Network. The film challenges elitist notions of innovation and validates informal creativity.

The Boy Who Harnessed the Wind

This Hollywood film narrates the story of William Kamkwamba, who builds a windmill using scrap materials to address drought-related water shortages in Malawi. The film demonstrates that innovation can emerge from necessity, persistence, and experiential knowledge even in the absence of formal scientific infrastructure.

Sociological Significance of Cinematic Representation

These films collectively reveal that grassroots innovation is deeply connected to social relationships, collective participation, and local knowledge systems. At the same time, cinema often romanticizes innovation by simplifying the structural struggles involved in sustaining and scaling such initiatives. In reality, grassroots innovators frequently face institutional neglect, financial insecurity, and social resistance. Nevertheless, cinematic representation plays an important role in reshaping public understanding of innovation by highlighting the agency of ordinary individuals and communities.

Social Implications and Developmental Consequences of Grassroots Innovation

Grassroots innovation produces significant social and developmental consequences because it reshapes how communities perceive knowledge, problem-solving, and collective participation within everyday life. Unlike mainstream technological systems that are largely dependent on institutional expertise and capital-intensive structures, grassroots innovation emerges from lived experiences, cultural practices, and local understandings of survival. In this sense, innovation becomes not merely a technical process but also a cognitive and cultural phenomenon shaped by mindset, perception, and community consciousness. The ability of marginalized individuals and local communities to identify possibilities within conditions of scarcity reflects a form of adaptive social intelligence rooted in experiential knowledge and collective memory (Gupta, 1996; Letty *et al.*, 2012) ^[13, 20].

Grassroots innovation therefore challenges dominant assumptions that innovation belongs only to formal scientific institutions or technologically advanced actors. Instead, it democratizes the very idea of innovation by recognizing local creativity, practical reasoning, and indigenous knowledge systems as legitimate forms of knowledge production. At the same time, grassroots innovation functions as a form of "solution science" that directly addresses practical and localized problems neglected by formal development systems (Pathak, 2008; Rajan, 2012) ^[22, 24]. Its developmental importance lies in producing low-cost, accessible, and context-specific solutions capable of improving everyday life within marginalized communities.

These innovations respond to issues such as water scarcity, agricultural inefficiency, mobility challenges, healthcare accessibility, and livelihood insecurity in ways that standardized institutional technologies often fail to achieve. Furthermore, grassroots innovation is deeply dependent on social relationships, informal networks, and collective trust. Reciprocity, cooperation, and community participation remain central to the emergence, sustainability, and diffusion of such innovations (Kaufmann & Stern, 1988) ^[19]. Strong social ties facilitate the circulation of knowledge, resources, and support systems, while weak social relations often restrict participation and limit the sustainability of innovation processes. This demonstrates that technological practices are never socially neutral but are embedded within wider social structures, cultural interactions, and community dynamics. Grassroots innovation therefore reveals how development itself is fundamentally relational, where technological transformation becomes inseparable from social cooperation, local participation, and collective agency.

Structural Contradictions and Institutional Challenges

Despite their social relevance and developmental potential, grassroots innovations continue to face multiple structural and institutional challenges that limit their sustainability, diffusion, and long-term transformation into broader socio-economic systems. One of the major challenges is financial exclusion. Most grassroots innovators operate with extremely limited financial resources and often depend on grants, voluntary labor, informal borrowing, or community contributions to sustain their activities (Middlemiss & Parrish, 2010) ^[21]. This dependence creates instability and prevents long-term planning, commercialization, and technological improvement. The lack of access to formal banking systems, institutional credit, and investment opportunities reflects broader structural inequalities in the distribution of capital, where marginalized innovators remain excluded from mainstream economic networks. Alongside financial barriers, grassroots innovations also confront complex institutional and regulatory constraints. Legal procedures, bureaucratic systems, intellectual property frameworks, and formal certification mechanisms are often designed in ways that privilege corporate actors, scientific institutions, and market-oriented enterprises while marginalizing informal and community-based innovators (Seyfang & Longhurst, 2013) ^[26]. As a result, grassroots organizations frequently struggle to scale their innovations or integrate into mainstream developmental structures. Another significant contradiction emerges from the localized nature of grassroots innovation itself. These

innovations are deeply rooted within specific socio-cultural and ecological contexts, which makes them highly relevant and effective for local communities. However, this same local specificity often limits their scalability and diffusion across different social environments. What works effectively in one region may not easily adapt to another because of differences in culture, geography, economic conditions, and social practices. Furthermore, despite improvements in India's broader innovation ecosystem, institutional support for grassroots innovators continues to remain weak and fragmented (Gupta, 2013) ^[26]. Poor infrastructural support, weak market linkages, limited technological assistance, and inadequate commercialization opportunities continue to push grassroots innovations to the margins of formal economic systems. Resource scarcity and economic insecurity also create difficulties in sustaining collective participation and volunteer engagement over long periods (de Vries *et al.*, 2015) ^[11]. Many grassroots initiatives depend heavily on community commitment and unpaid labor, but the absence of recognition, financial stability, and institutional backing gradually weakens participation. In addition, ideological disagreements, conflicting priorities, and differences in expectations among community members and stakeholders often create tensions that disrupt collective action. These conflicts are not merely interpersonal issues but reflect broader power relations, social inequalities, and competing developmental visions operating within communities themselves. Grassroots innovation therefore exists within a constant tension between local creativity and structural exclusion, where the very systems that celebrate innovation frequently fail to support those innovating from the margins.

Mainstreaming Grassroots Innovation: Policy, Power, and Institutional Support

Mainstreaming grassroots innovation requires more than symbolic recognition or temporary developmental interventions. It demands structural transformation in policy frameworks, institutional arrangements, and systems of knowledge recognition that have historically marginalized local innovators and informal knowledge systems. One of the most important requirements for strengthening grassroots innovation is the democratization of financial access. Grassroots innovators often remain excluded from formal financial institutions because they lack collateral, market legitimacy, and institutional visibility. Governments and development institutions therefore need to expand access to grants, micro-finance, subsidies, insurance facilities, and community-based funding mechanisms that can support grassroots initiatives in a sustained manner (Cabannes, 2012) ^[5]. However, financial inclusion should not be reduced to short-term welfare assistance. It must address deeper structural inequalities in capital distribution that prevent marginalized communities from participating equally within innovation economies. Alongside financial democratization, policy recognition and institutional inclusion are equally essential. Grassroots innovation needs to be integrated into national innovation, sustainability, and development policies rather than being treated as peripheral or informal activity. From a Foucauldian perspective, policy frameworks are not neutral administrative mechanisms but systems of power that determine visibility, legitimacy, and recognition. Inclusion within policy discourse therefore

becomes a form of institutional power through which grassroots innovation gains social and political legitimacy. At the same time, institutional infrastructure and technical support remain necessary for strengthening grassroots innovation ecosystems. Training programs, technical assistance, research collaboration, infrastructural development, and access to scientific resources can significantly enhance the capacity of grassroots innovators (Bradbury & Middlemiss, 2015) ^[4]. However, institutional engagement must avoid reproducing hierarchical knowledge systems that privilege formal scientific expertise while delegitimizing local experiential knowledge. Grassroots innovation should not be absorbed into formal systems in ways that erase its local character or community autonomy. Networking and collaborative platforms are also important because they provide grassroots innovators with access to information, legitimacy, markets, and social capital (Seyfang & Haxeltine, 2012) ^[25]. Yet these networks are themselves shaped by unequal power relations where dominant institutional actors frequently control the circulation of resources and opportunities. Therefore, collaborative systems require democratic and equitable participation mechanisms to prevent new forms of exclusion. In addition, grassroots innovators require advocacy support and political representation to challenge institutional marginalization and influence policymaking processes (Hoppe *et al.*, 2015) ^[17]. Innovation is ultimately connected to struggles over recognition, representation, and power within society. Public awareness campaigns and educational integration are equally necessary because they challenge elitist assumptions that innovation belongs only to technologically advanced experts and formal institutions. Recognizing grassroots knowledge as a legitimate form of knowledge production becomes a question of epistemic justice, where situated and experiential forms of understanding are acknowledged alongside formal scientific knowledge. Finally, grassroots innovation requires long-term institutional commitment rather than fragmented and temporary interventions. Sustainable support systems enable continuity, adaptation, diffusion, and broader socio-economic transformation, allowing grassroots innovation to evolve from isolated local practices into structurally recognized alternatives for inclusive and sustainable development.

Conclusion

Grassroots innovation demonstrates that innovation is fundamentally a social process embedded within everyday life, cultural practices, and collective survival strategies. It challenges dominant innovation systems that privilege formal expertise, centralized institutions, and market-driven outputs. In India, grassroots innovation reveals the creative capacities of marginalized communities who continuously develop adaptive solutions under conditions of scarcity, exclusion, and institutional neglect. These innovations are not merely technical responses but expressions of agency, resistance, sustainability, and localized knowledge production. However, despite their significance, grassroots innovations continue to face structural barriers related to finance, institutional recognition, diffusion, and policy inclusion. Mainstreaming grassroots innovation therefore requires more than isolated support schemes. It requires a structural transformation in how innovation itself is conceptualized, valued, and institutionalized. A genuinely

inclusive innovation ecosystem must recognize multiple forms of knowledge, democratize access to resources, and create participatory systems that allow communities to shape development on their own terms. Sustainable and equitable development cannot emerge solely from top-down technological systems. It requires integrating community-driven innovation, local knowledge practices, and grassroots participation into broader developmental frameworks. In this sense, grassroots innovation is not peripheral to development. It represents an alternative vision of development itself.

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