

## Review

## Grassroots innovation: A systematic review of two decades of research



Mokter Hossain

*Institute of Strategy and Venturing, Department of Industrial Engineering Management, Aalto University, Otaniementie 17, 02150 Espoo, Finland*

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## ABSTRACT

Grassroots innovation (GI) is an important strand for cleaner production and sustainable development. Studies have explored various facets of grassroots innovation. Despite two decades of research, however, there is no systematic review of the GI literature. The objective of this study is to synthesize the existing literature on GI. It identifies the main theories, characteristics, stakeholders, challenges, diffusion, and potential of GI, among others. The study points out how GI contributes to sustainability. It shows that only a few scholars have a significant contribution, which limits the broad expansion of the GI discipline. Moreover, GI literature has not been linked with the mainstream innovation literature. Even though GI is significant for sustainable development, its impact is limited in reality.

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## 1. Introduction

On 25 September 2015, the United Nations adopted the Sustainable Development Goals (SDGs), replacing the Millennium

E-mail address: [mokter.hossain@aalto.fi](mailto:mokter.hossain@aalto.fi).

Development Goals, to stimulate action over the next fifteen years in some areas critical for both humanity and the planet (Chin and Jacobsson, 2015; Lindberg, 2016). The SDGs emphasis lies heavily on cleaner production (De Medeiros et al., 2014). Cleaner production strategies promote waste reduction, recycling, and reuse at the ground level (Khalili et al., 2015). To solve many pressing environmental challenges, new advances in cleaner production have been designed to ensure sustainable societal development (Klemeš et al., 2012). GI plays a pivotal role in sustainable development. There are several definitions of GI in the extant literature (see Ustyuzhantseva, 2015). However, the most frequently referred definition is as follows: GI is “a network of activists and organizations generating novel bottom-up solutions for sustainable development and sustainable consumption; solutions that respond to the local situation and the interests and values of the communities involved” (Seyfang and Smith (2007), p. 585). GI is defined as innovation generated by civil society instead of government or business (see Tang et al., 2011). It is also defined as experimentation with technological change that involves a social movement component in support of a broad social change (Hess, 2007). Thus, some scholars argue that GI emerges from the community level whereas others believe that it does not necessarily emerge only from the community level. However, scholars have a consensus that GI is a bottom-up approach for sustainable development.

There are numerous grassroots innovations with varied nomenclatures which aim at sustainable consumption (Akenji, 2014). GIs represent social experiments of innovative technologies, values, and institutions (Haxeltine and Seyfang, 2009). GIs differ from mainstream innovation, as they possess different types of sustainable development and forms such as cooperatives, informal community groups, social enterprises, and voluntary associations (Martin et al., 2015).

The success of grassroots innovations occur at three levels: individual, group and societal (Grabs et al., 2016). GIs have not been adequately embraced as a source of innovation (Ornetzeder and Rohrer, 2013). Historically, grassroots movements include the community currency movements (Seyfang and Longhurst, 2013a), the People's Science movement (Kannan, 1990) and the Honey Bee Network movement (Gupta et al., 2003) and the technologies for social inclusion movement (Smith et al., 2014). Unlike mainstream innovation, grassroots innovations tend to operate without state or commercial interests (Yalçın-Riollet et al., 2014). They are not comprehensive and powerful for sustainable development, rather they are a source of innovative diversity (Seyfang et al., 2013). GI innovations stem from dissenting voices and movements, which demand a very novel vision and practice of innovation. Fostering entrepreneurial culture and innovative spirit is essential to promote GI (Hua et al., 2010). However, Jain and Verloop (2012) claim that grassroots and mainstream innovations bear numerous common features, and as such splitting them into one with the suffix ‘grassroots’ and another without it is not that necessary.

Studies on GI started around two decades ago. Until recent years, it has received limited attention from scholars. However, the last several years (2013–2015) have witnessed a surge of studies on GIs. Even though GI has become a well-established discipline, no systematic literature review has been done in this field. Hence, a comprehensive review of grassroots literature is essential. The objective of this study is to synthesize the existing literature on GI. Thus, it aggregates the current knowledge on GI in the scholarly literature.

## 2. Method

A systematic literature review approach is adopted in this study (Tranfield et al., 2003; Hossain & Anees-ur-Rehman, 2016). As a

keyword, “grassroots innovation” was used to search for appropriate articles from four databases. Only articles in English were included. To find appropriate articles, the first attempt on the Web of Knowledge database retrieved 31 articles. During the second attempt, 90 articles were found from the Scopus database, and during the third attempt, 19 articles were found from the EBSCO database. The fourth attempt was made on the ABI/INFORM Complete (ProQuest) database. Selecting the ‘only peer-reviewed’ option, 45 articles were retrieved from this database. Thus, 181 articles were collected from four selected databases and all these articles are placed on a single list. After removing 71 overlapping articles, 110 unique articles were considered for the next stage. Finally, 83 articles were selected after removing papers in such categories as book review (2), book chapter (6), book (3), conference (6), working paper (7), popular press (1), research note (1), and outlier (1). The articles were retrieved on December 7, 2015. Fig. 1 shows the steps of the overall article searching process.

As a part of the review process, two major steps were undertaken. First, the following basic information from each article was tabulated on spreadsheet: (1) the type of article and journal of publication, to understand the focus of the article; (2) the aim and main findings of the articles; (3) the unit of analysis, including geographic, industry, or firm focus; (4) key constructs and theories used in the articles; and (5) list of authors and their affiliation. Second, all selected articles were uploaded on Atlas.ti for thematic analysis. On Atlas.ti, by detailed reading, the main body of each article and key information was coded under emerging themes. The coding process was repeated to gain a rich compilation of knowledge under each theme. From numerous initial themes, ten major themes were developed by merging some initial themes. An inductive approach was applied for the purpose of coding and synthesis as it is an appropriate approach to condense extensive and varied texts into a summary format in order to establish linkages between objectives and summaries (Thomas, 2006). Thus, this study thematically analyzed and synthesized the main findings of the existing studies on GI. The following section includes the synthesized results.

## 3. Results

### 3.1. Characteristics of grassroots innovations

GI stems from the knowledge, experience and skills embedded in communities and individuals who lie outside the formal

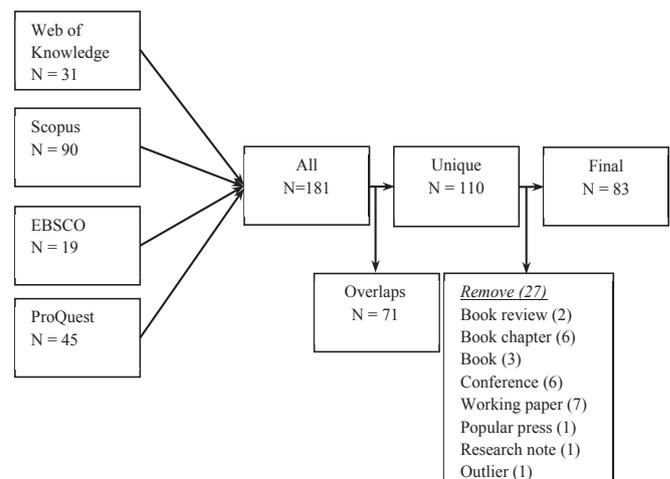


Fig. 1. Process and steps of searching for relevant articles.

institutions of education, research and industry for solving local problems (Reinsberger et al., 2015). GIs emerge when dominant innovations are locked-in and sustainable changes take place in a niche (Seyfang and Haxeltine, 2012). Mainstream research and development considers GIs as a peripheral agenda (Jain and Verloop, 2012). Innovation typically entails technical efficiency and the commercialization of science and technology, which disseminate in a top-down process (Neumeier, 2012). However, some scholars justify that grassroots organizations may not be as different from commercial organizations as many scholars of GI claim (Martin et al., 2015). Grassroots organizations possess knowledge and experience regarding what innovations are appropriate in localities for sustainable development by making meaningful and directly relevant resources available for locals (Roberts, 2005).

GIs emphasize social, cultural and ethical values that differ from mainstream innovations (Monaghan, 2009). The main characteristic of GI is that learning occurs in various dimensions over time and visions turn into more stable configurations (Geels, 2011). Some GIs do not aspire to expand and grow (Seyfang et al., 2013). A GI may come from outside of local communities but local knowledge and communities to frame a collaborative innovation activity are necessary (Smith et al., 2014). Typical examples of GI include community energy projects, organic foods supermarkets, local material recycling, community-based water and sanitation (Smith et al., 2014). These innovations are small-scale but highly sustainable (Phelps, 2013).

GIs have the potential to offer a more sustainable way of living than the existing unsustainable system (White and Stirling, 2013). Grassroots and mainstream innovations complement each other (Ornetzeder and Rohracher, 2013). Large firms embrace GIs but they make significant organizational and technical design changes in the process (Hess, 2013). GIs typically challenge the status quo, such as technologies, practices, and values. Moreover, they promote new forms of organization, and systems of provision (Seyfang, 2011). They also challenge the existing legal, regulatory, and institutional elements of their operating contexts (White and Stirling, 2013).

In a situation characterized by dominant market-based or science-based innovations, GIs prevail due to a culture composed of democracy, openness, diversity, practical experimentation, social learning, and negotiation (Ornetzeder and Rohracher, 2013). They are distinct from mainstream innovations at least in the following manners: (1) the driving force of GIs is a social need instead of rent seeking, (2) they are based on ideological commitment instead of profit seeking, (3) the protected space for GIs is created by values and culture, (4) they are established in communal ownership structures, (5) dependent on voluntary labor, grants, or mutual exchange, and (6) operate in a social context (Seyfang and Longhurst, 2016).

GIs, in opposition to conventional corporate innovations, have a transformative power and their roles are fundamental in the transition to sustainability (Leach et al., 2012). They have emerged as networks generating innovative solutions for many pressing challenges (Feola and Nunes, 2014) as an output of local experimentation (North, 2010). They support local niche creation via the incubation of socio-technical innovation facing mainstream values, technologies and actors (Martinez-Alier et al., 2010). Combining formal and informal science has become imperative for GI (Gupta, 2012).

Grassroots innovations eventually contribute to a global niche and they are adopted by mainstream regimes (Geels and Raven, 2006). The incorporation process can take place when large organizations own small organizations or a small organization transform into a large organization (Hess, 2013). Many GIs shift from a

marginal to a commercial organization over time (Hess, 2013) as they seek to emerge from a niche to a regime (Martin and Upham, 2016). In the early phases, the composition of networks of GIs differs significantly from the industrial innovations as GIs emerge mainly from citizens' innovations, unorganized lay people, hobbyists, craftsmen or local entrepreneurs (Ornetzeder and Rohracher, 2013).

### 3.2. Main theories used in grassroots innovation literature

GI has been mainly explored using theories such as strategic niche management (SNM) (de Vries et al., 2016), conceptual niche management (CNM) (Monaghan, 2009), niche-to-regime transition theory (Boyer, 2014), multi-level perspective (Ornetzeder and Rohracher, 2013) and knowledge economy (Gupta, 2012). GI literature has many mechanisms similar to the broader transitions literature such as community-based activity, niche source for low-consumption social movements and sustainable practice (Boyer, 2014). The sustainability transition literature aims to understand how technological innovations can diffuse and disrupt existing socio-technical systems through successful scaling up from the experimental niche (Seyfang and Longhurst, 2013a, b).

Niche theory, under social economy, is used to explain the dynamics of technological innovation. The social economy is often referred as a third sector, which is different from public and private sectors (Martin et al., 2015). Niches protect experimental innovations with radical movement from a too harsh state to regime (Raven, 2012). GIs are functional for various core processes of niche development including network formation, learning, and capacity building on the one hand, and empowering, nurturing and shielding niche innovations, the other (Ornetzeder and Rohracher, 2013). Some scholars believe that the difference between a niche and a regime is analytical, not ontological (Hoppe et al., 2015). Kirwan et al. (2013) hold that GIs do not intend to challenge the dominant regime; rather they concentrate putting local skills in action at the local level. In the right regime, niches support the diffusion of innovative socio-technical practices (Seyfang and Longhurst, 2013b).

The niche has emerged as a pivotal analytical category in the multi-level perspective (MLP) – a heuristic designed to offer tools to understand socio-technical change over time (Longhurst, 2015). The literature of GIs has emerged from socio-technical and sustainability transitions (Martin and Upham, 2015). Socio-technical changes as spaces are seedbeds of radical innovation (Seyfang et al., 2014). Niche growth happens when robust niche performance is combined with an existing regimes' compatibility (Smith, 2007). Regime change depends on broader dynamics including factors such as demography, economy, environment, infrastructure, materials, and paradigms (Rotmans et al., 2001).

Successful niches influence a regime by replication of innovations, installing multiple small innovations, scaling up and growing to attract more participants and eventually turn niche innovations into mainstream systems (Hoppe et al., 2015). Niche-innovation literature focuses on processes that are crucial for turning ideas into strong configurations (Ornetzeder and Rohracher, 2013). However, niche actors need to adjust the financial, legal, and regulatory structures of the mainstream to support the community (Boyer, 2014). Engineers and technological experimentation do not dominate niche creation; rather, a niche embraces experimentation with different types of social movements involving users in the process (Monaghan, 2009).

The SNM theory has three key elements: visions and expectations, networks, and learning (Kemp et al., 1998). The main objectives of SNM are to stimulate learning about the problems, needs, aligning visions and different interests of society, and building

networks for a collective goal (Hoppe et al., 2015). It mainly focuses on radical and unproven technologies for local development (Longhurst, 2015) and explains the dynamics of socio-technical GIs (Martin et al., 2015). SNM has emerged as a strand of research which seeks to know how to actively create and nurture niches developing sustainable innovation in order to trigger wider systemic transitions (Seyfang and Longhurst, 2013b). It implies that niches are closely networked with various stakeholders who aggregate resources to bolster niche innovations (Seyfang and Haxeltine, 2012). It indicates that investment in learning, consolidation and networking at the national level is a promising approach for niche development (Seyfang and Longhurst, 2013b). Different actors such as local authorities, citizen groups, NGOs, policy makers, and special interest groups may take the responsibility of conducting SNM (Hoppe et al., 2015).

The initial interest of SNM is to figure out how technological niches provide space to nurture experimental technologies (Hoogma et al., 2002). SNM concentrates on technological substitutions assuming that newness emerges in technological niches to conquer market niches and replace or transform regimes (Schot and Geels, 2008). SNM emphasizes key technology-driven experiments that spur research and development, and diffusion of innovations aiming to challenge an existing socio-technical regime (Hoppe et al., 2015). SNM theory advocates that niche actors and networks accumulate learning from local movements, disseminate the best practices and encourage diffusion of local innovations (Seyfang et al., 2014). SNM acknowledges the active role of users emphasizing local communities for eco-innovations through experiments to solve local problems (Henrekson, 2014). CNM complements SNM as a portfolio of transition approaches recognizing the important contribution towards system innovation linking it with other measures to maximize the potential of progressive social movements by promoting innovation (Monaghan, 2009).

The transition theory advocates that the success of individual transition innovations depends largely on regional or local framings (Feola and Nunes, 2014). Transition literature is interpreted with the combination of three interrelated strands: strategic niche management, multi-level perspective, and transition management (Caniels and Romijn, 2008). It explores the characteristics of successful niches by testing and developing new radical innovations (Seyfang and Haxeltine, 2012). Support from industrial, political and regulatory perspectives is vital for transition movements to scale up (Hess, 2013). The transition is a key shift in a socio-technical system on a wide range of domains such as the cultural, institutional, political, and technological domains (Seyfang and Longhurst, 2016). The transition movement comprises local innovations, presenting mainly the successful cases based on global diffusion and increasing visibility (Feola and Nunes, 2014). The transition has three principles (philosophies, policies, and practices) and three forms (life course, environmental, and political-economic) (Brown et al., 2012).

A successful transition movement significantly relies on vision, leadership, and (formal and informal) partnership with different local actors (Feola and Nunes, 2014). The role of leadership, positive dynamics, and trust in the leaders are crucial for a transition movement (Hoppe et al., 2015). A sustainability transition movement involves equity issues, such as intergenerational and within generation equity (Hess, 2013). Transition movements need closer recognition by GI actors and processes (Leach et al., 2012). The engagement of citizens is essential for transition (Ornetzeder and Rohrer, 2013). Many empowering institutions have embraced the knowledge economy to strengthen the negotiation ability of the knowledge rich, economically poor people at different scales and geographies (Gupta, 2012). Evidence-based practices de-legitimize the knowledge base in the affected communities by suppressing GI

and creativity (Boyes-Watson and Pranis, 2012). Only very recently have some studies emphasized the relevance of understanding the sustainability transition theory, which comprises such concepts as embeddedness, landscape, location, scaling, territoriality, and uneven development (Bridge et al., 2013; Caprotti and Bailey, 2014).

Seyfang and Haxeltine (2012) claim that transition literature demonstrates how socio-technological regime transformations emerge from an accumulation of innovations in niche spaces where radical innovations are tested and developed. Research on transitions is primarily concerned with the development and diffusion of market-driven technological innovations aiming at a sustainable society (Martin and Upham, 2015). Some studies on GIs attempt to understand the applicability of the transition theory originally developed to explore the dynamics of market-driven innovation (Seyfang and Longhurst, 2013a). A fundamental theme of the transition movement is re-localization to reduce dependency on the global market and expensive transport (Feola and Nunes, 2014). Re-localization implies diversification of local economies, reduction of the dependency on unstable global markets and the willingness to take direct action to foster innovation capacity without waiting for an established formal business sector (Feola, 2014). Transition movements typically address a narrow set of themes such as energy, food, transport, and local currencies (Hopkins, 2011). Transition management enables to experiment with alternative technologies (Boyer, 2014). Direct and frequent interactions between various transition innovations are an important factor for their success (Feola and Nunes, 2015). Urban regions are possibly more conducive to local transition movements (Feola and Butt, 2015). Transition movements in international comparisons are limited and the existing studies have overlooked the failure cases in favor of successful ones (Feola and Nunes, 2014).

### 3.3. Community-based and bottom-up organizations

GIs are a bottom-up approach mainly led by local communities or nonprofit organizations and they are different from the conventional top-down approach (Blake and Garzon, 2012). Bottom-up innovations tend to respond to local situations considering the interests of the communities (Seyfang and Smith, 2007). In the last two decades, bottom-up innovations have emerged as a useful approach for the sustainable system (Kirwan et al., 2013). An increasing body of literature on GIs has explored bottom-up innovations for sustainable development (de Vries et al., 2016). Mutual trust between communities is important in the formation of coherent communities. Innovation may often emerge from the margins such as communities in developing countries (Ely et al., 2013). Bottom-up innovation is believed to be more sustainable in tackling local problems at the community level. However, states focus on inducing top-down, conventional research and development in the realm of companies and research institutes with less emphasis on bottom-up innovations (Ross et al., 2012). Thus, states do not appreciate the role of GIs (Grin et al., 2010).

Grassroots organizations' main aim is to achieve community goals (Blake and Garzon, 2012). Communities of practice largely exist within grassroots associations (Bradbury and Middlemiss, 2015). However, there are no well-established identifying guidelines to know what a community of practice is (Haugaard, 2009). Community efforts emerge as a source of innovative solutions that typically comprises various interconnected elements. Community organizations tend to become commercial-oriented over time (Maier et al., 2014). Thus, the commercial orientation of the organizations enables the enhancement of their capability to mobilize resources, coordinate external relations and make an impact on society (Smith, 2000). Community currency is considered a new form of money to serve social, economic or environmental issues

which conventional money does not (Seyfang and Smith, 2007). It is mainly classified into four groups: service credits, mutual exchange, local currencies, and barter markets (Seyfang and Longhurst, 2013a). Community currencies are easier to replicate and adapt than technological innovations (Seyfang and Longhurst, 2013b). They comprise innovations such as community hall renovation, collective behavior change and locally owned renewable energy (Seyfang et al., 2014). Community currencies have received state supports in some countries such as Brazil and Venezuela (Seyfang and Longhurst, 2013a).

### 3.4. Challenges

GIs face a range of challenges. They need support not only on one occasion but also all along the value chain (Cabannes, 2012). They rely on low-level finance (Middlemiss and Parrish, 2010), face ideological disputes (Seyfang and Longhurst, 2013a, b), and struggle to create appropriate links with a wider community (Smith, 2011). Major challenges for GIs are financial, legal, pressures/compulsions of circumstances, and diffusion (Boyer, 2014). GIs encounter many challenges if they are to trigger social change effectively (Feola and Nunes, 2014). Turning a well-identified demand to a “business plan” is a key challenge for GIs (Cabannes, 2012). A key challenge for GIs is to connect local innovation capacity with the global parameters (Leach et al., 2012). Developing genuine GIs are challenging (Martin et al., 2015). A niche within an existing regime provides very little change whereas a radical niche may fail to translate its practices to the regime, as the practices demand numerous structural changes (Seyfang and Longhurst, 2013b).

GIs with strong local specificity of cultural, social and technological landscapes (Ornetzeder and Rohracher, 2013) face numerous challenges when expanding in the global environment (Devine-Wright and Wiersma, 2013). GIs may not develop robustness and resilience in case of burnout of activists, funding cuts, key people leaving, shifts in policy, and turnover of volunteers (Bradbury and Middlemiss, 2015). Keeping members and volunteers especially in the initial stage with resource constraints is a key challenge (de Vries et al., 2016). Short-lived innovations are often not properly documented for learning purposes as such skills and learning are not available for new incumbents (Seyfang and Smith, 2007). Creating appropriate funding mechanisms such as co-funding, small grants, subsidies, and insurance facilities are necessary to stimulate local innovations (Hoppe et al., 2015). GIs are funded through donations, fundraising events, grants, lotteries, private sponsorship, sale of self-produced goods, local authorities, and sponsorships (Feola and Nunes, 2014). Financial support for GIs in urban areas is very limited as donors and specialized financing institutions do not consider, for example, urban agriculture a substantive issue (Cabannes, 2012).

GIs face difficulties to connect with skilled people, research institutes, and advisers to get necessary support such as access to information and finding communications channels to promote their success (Creech et al., 2014). GIs have the difficulty of keeping pace with the changing environment (Douthwaite et al., 2009). The uneven diffusion of GIs challenges the existing narratives on their momentum (Wu and Zhang, 2013). They struggle simply to survive, let alone to grow (Hargreaves et al., 2013). Establishing institutional infrastructures is very difficult due to diverse interests of stockholders (Hargreaves et al., 2013). GIs for system change are likely to be incremental on a range of characteristics to strengthen the incumbent regime such as cognitive frameworks, embedded practices, and prevailing norms (Hoppe et al., 2015). They need to adopt an active lobby for political and institutional support (Ornetzeder and Rohracher, 2013). Grassroots organizations are subject to indirect pressure to become non-profit by commercial

organizations (Martin et al., 2015). Community members of grassroots innovations are often reluctant to pay their membership fees if the results of an initiative are not visible (de Vries et al., 2016).

Grassroots organizations struggle between recognizing appropriate technology supporting grassroots ingenuity and context sensitive solutions. Moreover, they have a risky reliance on external support (Smith et al., 2014). Yet, they tend to disseminate technologies to poorer communities, in general. Cabannes (2012) considers that urban grassroots innovations are quite reluctant to approach formal financial institution for loans. Less powerful non-business actors are predominantly involved with GIs. Consequently, grassroots innovations do not attract the adequate attention of policymakers (Bergman et al., 2010). The exclusion of segmented, scattered and small-scale innovations from the agenda of public policy is a very common practice (Gupta, 2012). Networking is a key to overcome many challenges as described in the follow section.

### 3.5. Networking

Networking is an important step of GIs for upscaling and transcending the local milieu (Hoppe et al., 2015). The success of GIs largely depends on pre-existing networks in context, place, scale, space, and socio-technical change (Feola and Nunes, 2014). Networking activities are supportive for niches when they work in collaboration with various stakeholders (Seyfang and Haxeltine, 2012). Adaptations of GIs have emerged from interpersonal communication and social networks (Anderson and McLachlan, 2012). Network building activities focus on the internal dynamics of communities to create community momentum (Kirwan et al., 2013). Robust networks provide the innovative implementation of projects over time (de Vries et al., 2016). A strong international network of civil societies significantly helps to develop sustainable GIs (Ely et al., 2013).

Social movements are loosely framed in horizontal networks that are unlike hierarchical and centrally operated networks (Nicholls, 2007). GIs emerge from networks of activists generating bottom-up solutions for sustainable development (Leach et al., 2012). Networking with both local and global actors significantly helps GIs (Feola and Nunes, 2014). Even in the local context, Gupta (2012) argues that collaborating with supportive actors such as designers, fabricators, and funders is essential for developing GIs. To create socio-cognitive ‘niche’ protection for sustainability experiments, concentration of cultural practices, institutions, and networks are important (Longhurst, 2015). However, networking between actors in grassroots niches is more limited than networking in successful market niches (Martin et al., 2015).

Establishing a network of interactions between niches, regimes and landscape is essential to understanding the growth of a niche (Ornetzeder and Rohracher, 2013). Increasing the network of actors can expand the resource base of niche activities in various contexts and create more sustainable relations between relevant actors involving national level governance structures (Geels, 2011). Grassroots networks usually have limited access to scientific knowledge, expertise and modern means of production (Ornetzeder and Rohracher, 2013). Networking gives codified learning via training, which provides support such as how to set up and run a grassroots movements that include ideological issues (Seyfang and Haxeltine, 2012). Networking helps to lobby, to know best practices, and to develop standard and institutionalize learning (Seyfang and Longhurst, 2016). Grassroots innovations can use the intra-organizational network for their growth (Xiao et al., 2013). Intermediaries play a key role in networking (Seyfang et al., 2014).

### 3.6. Intermediary

Intermediaries can help to form connections between niches and regimes by stimulating regime change (Smith, 2007). They can be various types such as culture, society, knowledge, labor, market, planning, and welfare intermediaries (Medd and Marvin, 2008). Intermediaries facilitate support in different contexts such as local, policy, market, and social contexts (Hargreaves et al., 2013). Intermediaries mainly play the following roles: initiation of new projects, interaction with policy makers and other agencies, lobbying, institutionalization of learning, provision of tools, raising resources and funding, setting standards, sharing information between various community groups, and tracking a program (Maier et al., 2014). However, White and Stirling (2013) argue that grassroots organizations and intermediaries experience similar pressures on their growth.

Intermediaries are necessary for the replication of niche projects in various locations (Seyfang and Longhurst, 2016). However, they cannot translate some important aspects such as confidence, tacit knowledge, and trust to new settings (Seyfang et al., 2014). Intermediaries play a key role in helping small-scale GIs to scale-up to replace the existing mainstream provision (Geels and Deuten, 2006). However, the role of intermediaries in helping GIs to grow has been very limitedly explored in the literature (Hargreaves et al., 2013).

### 3.7. Learning

Learning gives GIs the opportunity to gain knowledge and expertise on how to improve innovations from experiments (Hoppe et al., 2015). Bradbury and Middlemiss (2015) claim that the most important enabler of learning within an association is the culture of education. A range of structural conditions at the local level is necessary for learning (Ornetzeder and Rohracher, 2013). However, the processes of learning occur not only at the local level but also at the global level (Seyfang and Longhurst, 2013b). A learning process is effective when negotiations, knowledge, and information are treated as open source (Ornetzeder and Rohracher, 2013). Learning leads to gaining skills, knowledge, and transform an association to a sustainable one (Bradbury and Middlemiss, 2015). Internal learning is beneficial to develop shared objectives and common understanding to create a coalition of various groups of activists (Seyfang and Haxeltine, 2012). Bradbury and Middlemiss (2015) found that learning by doing or learning by seeing is more effective than formal learning for sustainable practices. Training and use of hands-on practices are fundamental to introduce GIs especially in rural areas (Pattnaik and Dhal, 2015). Active engagement provides participants the necessary room to learn new skills (Bradbury and Middlemiss, 2015). Learning a sustainable policy regime from the grassroots and local service providers is pivotal in establishing flexible enough policies to bolster bottom-up innovations (Monaghan, 2009).

Ornetzeder and Rohracher (2013) point out that a democratic structure is a key aspect of a learning environment. In addition, learning is accelerated by a balanced composition of actors with complementary competencies. Without the human resources of participants such as knowledge, skills, time, and commitment, learning may not be transferred between generations of participants (Bradbury and Middlemiss, 2015). Configurational technologies exist as a process of practical learning wherein technologies, skills and organizations evolve over time (de Vries et al., 2016). Experiential and interactive learning helps to aggregate decision making during GI processes (Douthwaite et al., 2009). Studies depict that some GIs map, replicate, and develop through learning processes by peer-to-peer knowledge dissemination (Feola and

Nunes, 2014).

The training on GIs is mainly based on successful experiences and thereby sharing knowledge is a part of learning and niche building (Feola and Nunes, 2014). For extreme affordability, learning from grassroots innovators and traditional knowledge holders is essential (Gupta, 2012). Learning should be an ongoing process for both grassroots organizations and intermediaries (Hargreaves et al., 2013). Learning processes help to garner knowledge and expertise regarding how to improve innovations from repeated experiments (Hoppe et al., 2015). Seyfang and Haxeltine (2012) state that first-order and second-order learning are essential to aid niche development and diffusion. As second-order learning, niche actors can retrospect on present development and practices; thereby question the premises of regime systems, alternative cognition and ways of evaluating niche development (Kirwan et al., 2013). Even though learning happens in various experiments, Monaghan (2009) suggests that learning and reflection should occur throughout the entire process. Policy regimes need to learn from the grassroots to better formulate policies that are friendly to bottom-up innovations with little irreversibility (Kemp and Rotmans, 2004). For opening creative spaces of learning, the understanding of various preconditions in a specific locality are essential (Ornetzeder and Rohracher, 2013). The existing curricula, policies, and programs neglect the need of learning from knowledge-rich but economically poor people (Gupta, 2012).

### 3.8. Success of grassroots innovation

The success of GIs is defined in many ways in the extant literature (Ornetzeder and Rohracher, 2013). According to Feola and Nunes (2014), the success of transition innovations is defined based mainly on four factors: human, external, organization and resources. Moreover, they point out that success can be measured considering issues such as social links within the local communities, contribution to improved environmental performance, empowerment, social functions, social connectivity, and trajectories of GIs (Feola and Nunes, 2014). Seyfang and Longhurst (2015) posit that the success of GIs is perceived mainly on dimensions such as scaling, replication, and translation. Successful growth of niches depends on expectations, social networks, learning and leadership (Hoppe et al., 2015). Distinct GIs may elaborate different narratives, which may influence their internal and external dynamics differently (Feola, 2014). The change in socio-technical regime also heavily depends on broader dynamics such as demography, material infrastructure, natural environment, and paradigms (Rotmans et al., 2001).

There are various views as for the success of GIs. For example, some innovations emerge without any ambition to expand but to serve a particular community. Other innovations opt for growing beyond the locus of their origins (Ornetzeder and Rohracher, 2013). The potential to contribute to the environment is considered a key success factor bearing the financial attractiveness of GIs (Reinsberger et al., 2015). Smith et al. (2005) opine that the success of GIs depends on the simultaneous pressure of the niche, landscape, and available opportunity for change.

In one hand, radical niches provide an environment for sustainable experiments, on the other, different values and expectations among actors hinder to de-contextualise, scale up and translate GIs into mainstream contexts (Ornetzeder and Rohracher, 2013). The main benefits of GIs derive from their creation of a space to develop new ideas and practices, and experimentation with new systems of provision, which enable the citizen to express alternative values and gain tangible accomplishment (Seyfang and Haxeltine, 2012). Capability development is necessary to scale up

a grassroots movement into a large-scale national program (Blake and Garzon, 2012). The evidence of scaling up GIs is still limited (Bergman et al., 2010). Moreover, Gupta (2012) holds that a general refrain in the innovation literature is that scale is necessary for sustainability. Scaling of GIs is difficult due to their geographical rootedness (Seyfang and Smith, 2007).

### 3.9. Diffusion of grassroots innovations

The diffusion potential of GIs is very different from those of technological innovations (Seyfang and Haxeltine, 2012). Radical socio-institutional and socio-cultural changes are necessary for the diffusion of GIs into the mainstream (Monaghan, 2009). To promote the diffusion of GIs, considering the proposition of values and highlighting the types of practices in context are important (Hargreaves et al., 2013b). Seyfang and Longhurst (2016) hold that niche-level activity correlates with diffusion success. GIs need to balance between successful diffusion and innovation control (Ornetzeder and Rohracher, 2013). Niche development is essential but not sufficient for the wider diffusion of GIs. Wu and Zhang (2013) point out that the diffusion of GIs is different from mainstream innovations, as the latter does not consider the complexity and diversity of local, ecological, economic, and social contexts.

To what extent GIs represent spaces for radical innovation for sustainability, how they emerge, and their characteristics are keys for their diffusion (Feola and Butt, 2015). Success in terms of widespread diffusion comes at a cost of cooptation (Hess, 2013). Social movement diffusion is transfer in the same or similar forms across space, sector, and ideological divides. The diffusion is spatially structured, which is determined by the uneven distribution of contextual factors (Feola and Butt, 2015). Above all, the significance of a GI lies on its sustainability aspect.

### 3.10. Sustainability

Conventional sustainable development policy for modernization solutions embracing market transformation and green growth is criticized for its limited scope and ambition (Seyfang, 2009). Innovation and community action are considered two vital strands for sustainable development (Seyfang and Smith, 2007). An alternative narrative has emerged around GIs to tackle the unsustainability, injustices, and inequalities of mainstream innovations (Martin et al., 2015; Seyfang and Longhurst, 2016). A few studies have explored the grassroots movement for sustainability, mostly from the theoretical points of view. Seyfang (2010) found that many community-led GIs for sustainable development emerge to effect a wider transformation of mainstream society. Community actions are becoming an integral part of sustainable policy for various fundamental reasons such as the necessity of active citizens and strong local institutions and locally originated actions to create socially embedded changes (Burgess et al., 2003).

Most studies focus on market-oriented innovations whereas socio-technological sustainable alternatives emerging from the grassroots level have received limited attention (Hargreaves et al., 2013). The role of GIs to embrace more sustainable systems of production and consumption has not been given sufficient credit in science and policymaking (Ornetzeder and Rohracher, 2013). Sustainability is a key issue that upholds GIs in an applauded position. Grassroots organizations are concerned about the existing unsustainable ways of consumption when people can live resource poor but satisfying lives (North, 2010). The transfer of skills and knowledge to new incumbents of grassroots organizations naturally bring out sustainability within the grassroots association (Bradbury and Middlemiss, 2015).

Along with new sustainable technology, users teaming in self-

building groups adjust their specific needs (Ornetzeder and Rohracher, 2006). In rural communities, the ability to innovate is an important aspect of sustainability (Douthwaite et al., 2009). The uneven diffusion of grassroots networks is associated with cross-movement transfers, institutional thickness, and interplay of different proximities in GI diffusion (Feola and Butt, 2015). Scalability is a great concern for GIs but it is a key condition for sustainability (Gupta, 2012). GIs with sustainability involve a radical vision of the existing regime and a sustainable future (Hess, 2013). Even though the research body on sustainability transitions is noticeable, the geographical aspects of sustainability are apparently highly overlooked (Coenen and Truffer, 2012). A growing interest in civil society, as an overlooked aspect, has significant promise to contribute to sustainable consumption systems (Martin and Upham, 2015).

## 4. Discussion, limitations, and future research

### 4.1. Implications

The importance of GI has been neglected for a long time. It has yet to receive adequate attention from scholars, practitioners and policy makers. There is no common understanding among scholars on GIs. Some scholars see it in the urban context at the community level (Seyfang and Smith, 2007) whereas others consider them mainly in the rural context (Gupta, 2008, 2012). Most of the studies use the definition of GI given by Seyfang and Smith (2007). Thus, an evolution of the definition has not been found in the literature. The study underscored the scope and characteristics of GI to clarify the concept. GI has not received the attention of mainstream innovation scholars. Consequently, it has remained isolated from the mainstream innovation literature. Most of the studies have been published in journals focusing on sustainability and environmental issues. Moreover, only a few scholars are dominant in the literature.

This study's discussion about the main theories in GI literature provides a rich understanding of GIs from a theoretical perspective. Grassroots innovations face numerous challenges, many of which are unimaginable in mainstream innovation. The study has provided a comprehensive understanding of the challenges grassroots innovations encounter. Even though GI is seemingly promising to create alternatives for sustainable development, they are loosely connected with mainstream socio-technical regimes and have a weak impact in reality (Seyfang and Smith, 2007).

Networking is an important way for grassroots innovations to expand especially from one location to the other. However, they are connected in horizontal networks in place of hierarchical networks.

This makes them different from mainstream innovations, which work based on hierarchical networks. Intermediaries are key to establish different kinds of networks for GI. They are also highly relevant for learning purpose.

The success of grassroots innovations is measured with some unique parameters, such as the number of members, social links, social functions, and environmental performances. These parameters are very loosely defined and not used in the mainstream innovation literature. GIs complement regimes in the small scale. Consequently, they are ignored in political and policymaking discussions. Diffusion of most of the innovations is limited due to their geographical rootedness. However, grassroots innovations are highly applauded for their sustainable contribution.

### 4.2. Limitations

There are several unavoidable limitation to this study. Firstly, it has provided an overall synthesis of the results. Consequently, a very deep analysis of many topics was impossible. Secondly, it

considered studies which exclusively used the GI concept. Thus, there might be studies that explored the same phenomenon with different concepts such as frugal innovation (Simula et al., 2015; Levänen et al., 2016), social innovation (Brown and Wyatt, 2015), ecological innovation, environmental innovation, green innovation, and sustainable innovation (Schiederig et al., 2012). Thirdly, GI is understood in different ways both geographically and conceptually which was not explored in this literature. Finally, no distinct analysis was performed to understand GI versus mainstream innovation. These limitations along with the synthesis of the study present opportunities for future research.

#### 4.3. Future research

This study provides a set of research avenues based on the analysis of the results, recommendations, and suggestions mentioned in the extant literature. Despite high relevance, some theories such as the resource-based theory and the agency theory are not present in the literature.

Most studies have merely narrated various cases of grassroots innovations. There are only a few studies on innovations in the unorganized sector compared to managerial innovations. Innovation research has recognized the importance of GIs, yet it remains as a statement of faith without spawning adequate conceptual and empirical analysis (Lorentzen and Mohamed, 2010). Studies on innovations have provided limited attention on low-income countries in general and GIs in particular (Gupta, 2012).

The significant contribution of GIs for sustainability has been neglected (Seyfang and Smith, 2007). The widespread diffusion of a GI is considered as a success, which comes at a cost of cooptation (Hess, 2013). Yet, diffusion and cooptation have not been seriously explored together in the extant literature (Martin et al., 2015). Survival is a common challenge across all grassroots innovations. Evidence on their extensive growth, replication, and diffusion is not available in the literature (Seyfang et al., 2014). Even though intermediaries play a key role for GIs to develop and grow, only a few studies have examined the nature and extent of their roles (Hargreaves et al., 2013). How different niche activists mutually share and benefit from each other needs rigorous exploration in future studies. The evidence shows that grassroots innovations may effectively be transferred from one location to another (Feola and Nunes, 2014). However, the extent of transfer in practice is limitedly known.

Rigorous studies on GIs to clarify various stakeholders and their roles are necessary. The potential of bottom-up innovations is seemingly enormous, and as such, future research in that direction may increase the understanding of how to reap societal benefits. How GIs can be integrated into incumbent systems is not clear from the existing literature (Monaghan, 2009). Radical innovations that emerge from the community level is limitedly examined using strategic niche management (Seyfang and Longhurst, 2016). Studies point out that GIs transform from a niche to a regime. How it takes place in practice needs investigation in the future. The extant literature mainly includes successful cases of GI whereas exploring failure cases may significantly help to learn about grassroots innovations. This study is expected to stimulate research with the aim of addressing the limitedly known issues that are associated with grassroots innovations.

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