Grassroots innovation for sustainable development: some enduring dilemmas

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Adrian Smith and Elisa Arond
Mariano Fressoli and Hernán Thomas
Dinesh Abrol

STEPS Centre and SPRU, University of Sussex, UK
Instituto de Estudios de la Ciencia y la Tecnología – Universidad Nacional de Quilmes, Argentina
National Institute of Science Technology and Development Studies (NISTADS), India

Abstract: Technologies for social inclusion in Latin America are a recent manifestation of grassroots innovation movements that can be traced back to the appropriate technology movement of the 1970s and earlier. Common to these movements is a vision for socially just innovation processes more inclusive towards local communities in terms of the processes and outcomes involved. Comparing technologies for social inclusion and appropriate technology movements reveals three enduring dilemmas associated with grassroots innovation: attending to local specificities whilst simultaneously seeking wide-scale diffusion and influence; being appropriate to existing situations that one ultimately seeks to transform; and, working with project-based solutions to goals (of social justice) that require structural change. Responses to each dilemma spur the creation of different forms of knowledge, and which is of value to innovation policy debates. Constructive policy engagement requires frameworks for capturing and understanding the knowledge being produced. This has to be done with great sensitivity and appreciation towards the worlds of grassroots innovation movements: too prescriptive and rigid a framework risks both distorting and bracketing out inconvenient forms of grassroots knowledge. With sensitivities in mind, we elaborate four framings of knowledge production in grassroots innovation movements: coping strategies; visionary vanguards; R&D labs for utopia; and reflexive plurality. Taken in the round, these framings indicate how grassroots innovation movements can contribute to innovation policy debates.

1 Introduction

An undercurrent of critique accompanying modern industrialisation includes experimentation with alternative forms of grassroots innovation. Grassroots innovation movements have sought innovation processes that are more socially inclusive towards local communities in terms of the processes and outcomes involved. Whether focused in resource-based sectors, or manufacturing and services; whether in rural or urban settings: dissenting voices and

movements periodically call for a quite different vision and practice of innovation and technological change (Illich, 1973, Dagnino, 2009).

Mainstream innovation policies focus upon rent seeking firms developing new products, processes and services in conventional (globalising) markets. Good practice in innovation policy is considered to nurture partnerships between firms and science and technology institutes, fosters entrepreneurship, and incentivises investment in innovation activities (OECD, 2010). Often, policy aims are expressed as an industrialisation imperative to catch-up with or keep-up with an apparently universal techno-economic frontier, currently based in information-, bio-, and nano-technology (Freeman, 1992, Perez, 1983, Bell and Pavitt, 1993).

Grassroots innovation movements, in contrast, often arise in reaction to perceived social injustices and environmental problems in conventional industrialisation models. It is no coincidence, for instance, that the resurgence of Brazilian and Indian economic power in recent years – and the persistence of structural inequality - has been accompanied by renewed calls for patterns of innovation and development appropriate for those left behind in those countries (Dagnino, 2009, Abrol, 2005, Gupta et al., 2003).[1] Examples historically include, the appropriate technology movement in the 1970s, the People's Science Movement in India in the 1980s; and today include, the Honey Bee Network in India, and the technologies for social inclusion movement in Latin America. We group these initiatives under the label 'grassroots innovation movements' (Seyfang and Smith, 2007).[2]

Grassroots innovations rarely feature in the foresight exercises and innovation policies of elite scientific, technology and innovation communities. Grassroots innovation is an explicitly normative agenda, which seeks to mobilise distinctly political processes, such as claims to social justice, and often questions organisational and economic assumptions in conventional innovation policies.[3] Alternative initiatives tend to arise in civil society and solidarity economy arenas, where groups experiment with social innovations as well as developing 'appropriate technologies' responsive to local situations and needs. Movement emphasis is on affordable technologies and practices that provide livelihoods and empower local communities to have greater control over their own development. By this definition, the grassroots *innovations* for, say, locally-appropriate house construction techniques for the urban poor in Argentina are very different to innovations in small-scale food processing techniques for the rural poor in India. Nevertheless, grassroots *innovation processes* share a broadly similar vision and shared set of principles, which means they also share similar dilemmas.

In this paper we compare recent experiences with technologies for social inclusion in Latin America with the dilemmas arising under an earlier appropriate technology movement in the 1970s. Our purpose is to explore how enduring dilemmas identified in the contrasting periods and contexts of both grassroots innovation movements can act as sources of knowledge production important for technological forecasting and social change.

[1] In China too, there is revived interest in grassroots innovation; whilst segments of wealthier societies too, confronting their environmental legacy, have seen grassroots innovation movements (Seyfang and Smith, 2007; Smith, 2006).

[2] In this text we refer to "grassroots innovation movements" as social movements which use local knowledge and participatory technological change as a tool for social inclusion and sustainable development. This definition embraces a variety of community based movements and is not as restricted as, for example, Anil Gupta's definition of "grassroots innovation", which looks at the local processes generating individual artefacts (though Gupta's Honey Bee network also helps builds a broader movement) (Gupta *et al*, 2003).

[3] Conventional innovation agendas are also normative, but their assumptions and consequences are often left implicit.

A number of analysts have argued technological controversies constitute informal forms of constructive technology assessment, in the sense that people can learn from the very different 'framings' of the technology being protested and debated. These analysts suggest social learning might be enhanced when controversies are viewed and engaged in that light by policy-makers (Rip, 1986, Woodhouse et al., 2002, Jamison, 2002, Waks, 1993). We argue that the dilemmas confronting grassroots innovation movements should be taken seriously in a similar vein (Smith, 2005, Smith, 2007). Responses to these dilemmas generate knowledge relevant to policy for sustainable innovation, understood after Brundtland to mean socially just and environmentally sustainable innovation (World Commission on Environment and Development, 1987). We propose a framework for appreciating the diverse knowledge production generated by these movements.

Whilst relations with mainstream innovation policy will always be difficult, and whose politics over different knowledge claims we cannot go into in this paper,[4] grassroots innovation movements nevertheless constitute experimental spaces that can enhance the plurality and reflexivity of innovation policy. At a time when innovation policies are increasingly called upon to address societal challenges like poverty and sustainability (OECD, 2010), the knowledges produced by grassroots innovation movements should be taken seriously; not as a blueprint for the future, but rather as a resource for debating and constructing different pathways to sustainable futures.

The paper is structured as follows. Section two introduces the technologies for social inclusion movements in Brazil and Argentina, and discusses some of the issues arising amongst participants. There are many uncertainties, and so we provide some historical perspective in section three by recalling the experience of the appropriate technology movement in the 1970s. Common to both movements are a number of dilemmas, elaborated in section four. We suggest in section five that, in learning to live with these dilemmas grassroots innovation movements produce different forms of knowledge, and how they can be considered as nurturing experimental spaces for sustainability. We conclude in section six, where we explain why engaging grassroots innovation movements in innovation policy will not be easy, even if its beneficial potential is agreed.

2 Technologies for social inclusion in Latin America

Latin America has a long and rich tradition of grassroots innovation movements dating back to appropriate technologies in the 1970s. Based on this tradition, and following other social movements and public protests against neo-liberalism in the region, during the 2000's various strands of thinking, ideas and institutions concerned with technology and development began to gather together. Actors involved in this process included public institutions, R&D laboratories, universities, NGOs, cooperatives and factories reclaimed by their workers. Interest in grassroots innovation ranges from the Social Technology network in Brazil, to the cooperative movement in Uruguay, R&D extension units in Argentina, as well as other

[4] The analysis in this paper is informed by the authors' involvement in a series of projects into the topic of grassroots innovation movements in South America, India, and Europe. Research has included in-depth interviews with practitioners, the organisation of workshops, visits to project in the field, and extensive review of activists and analytical literatures. Ongoing research funded by IDRC and the ESRC is looking at the knowledge politics involved.

approaches active in the region, like agroecology and solidarity economy. For the sake of simplicity we group these movements under the umbrella label of technologies for social inclusion.

One of the most important and articulated movements in Latin America is the Social Technology network in Brazil. The social technologies network emerged originally in Brazil through long-standing discussions and debates about technology, development and social inclusion in the country. A formal network of organisations dedicated to 'social technologies' (RTS, *Rede de Tecnologia Social*) was established in 2005. There are over 900 member organizations in RTS, including non-governmental organisations, universities, private firms and state organisations. Membership includes organisations in other Latin America countries. Discussions leading to the network have to be seen in the context of the social activism and programmes of social movements and the Worker's Party in Brazil and that eventually propelled Luis Inácio Lula da Silva into government in 2003. Less formalised networks are appearing in other countries of the region, such as Argentina, as well as individual organisations and initiatives using similar ideas and terminology. In this sense, the social technology network in Brazil is a particular manifestation of a broader movement for grassroots innovation in the region.

Two members of the Executive Secretariat of RTS define social technology as follows: "The concept of social technology used by the RTS includes products, techniques or methodologies that are replicable, developed by interaction with the community and presents effective solutions for social transformation. The idea of *replicability* has implies [sic] that when a social technology is used in a place different from where it was developed, it has to be recreated, appropriated to the new reality, bringing new values, knowledge and meanings. Thus, the concept of social technology adopted reflects a dynamic and interactive innovation and learning process" (Miranda et al., 2011).

Central to this vision is the concept of replicability or *re-application* of technologies with the full participation of local communities, and whose repetition in myriad processes sees social technology achieving large scale influence. According to Fonseca (2009), 're-application' of technologies implies: a) reproduction adequate to the local space, b) appropriation by local population, and c) assessment of results for new re-applications. Knowledge production with the local communities involved is intended to be intensive and empowering. As we shall see, this view sits uneasily with more entrepreneurial perspectives that view social technology as the diffusion of artefacts through markets.

Significant support for social technologies comes from organisations with positions in corporate responsibility, social enterprise and social policy.[5] Thus the social foundations of banks, large corporations, as well as various government ministries, including science and technology and the Brazilian innovation agency, are all involved in RTS. Over the period 2005 to 2009 state and corporate organisations have invested US$175 million in social technology projects and activities (Miranda et al, 2011). However, beyond reliance upon funding from these sources, the links to the science, technology and innovation community in

[5] Included in the Co-ordinating Committee of the RTS, for example, are FINEP (Financiadora de Estudos e Projectos, the main Brazilian innovation funding agency); Caixa Economica Federal (a large, state-owned bank); Petrobras (the state oil and gas enterprise), Fundação Banco do Brasil (the social fund of the Bank of Brazil); SEBRAE (Serviço Brasileiro de Apoio às Micro e Pequenas Empresas, the micro and small business support service); and the Ministries of Ciência e Tecnologia (Science and Technology), Integração Nacional (National Integration), Trabalho e Entrego (Labour and Employment), and Desenvolvimento Social e Combate à Fome (Social Development and Fight against Hunger).

Brazil are weak (see below). The official view of social technology is as a programme for social development rather than the incubation of important innovations (Fonseca and Serafim, 2009).

Indeed, the impetus for a formal network in Brazil derived from the creation of a Social Technology Prize organised by Fundação Banco do Brasil in 2001. The annual Social Technology Prize led to the accumulation of a database of entrants and award-winning projects (further augmented by the RTS). Since then, social technologies have been identified, developed and promoted in the areas of agro-ecology, recycling, sustainable energy, housing and infrastructure, and rainwater harvesting; and the provision of training programmes and funds for the incubation of small-scale, co-operative enterprises aims to support the marketing of social technologies. Whilst some network activities remain focused on creating a database of social technologies, and the dissemination of activities addressing specific issues, other participants (including members of the RTS Executive Secretariat) envisage social technologies as a much wider project for social transformation. The vision and principles for social technology include a commitment to grassroots involvement. "It is built and reapplied from proactive, collective, solidarity and democratic means. Knowledge production occurs alongside the deepening of community awareness, scientific knowledge coupled with local and traditional knowledge" (Miranda et al, 2011: 151).

Unsurprisingly, there is flexibility in the way these principles are interpreted and put into practice, as the following three examples of technologies for social inclusion illustrate.

The first example illustrates a major case of social technology in Brazil. This is the Cisterna programme for the semi-arid regions of north-eastern Brazil. It is claimed this replication programme has brought rain-water harvesting techniques to over 1.5 million people. A related programme of farm-scale rain-water harvesting reached over seven thousand families in 247 municipalities in the region (RTS, 2010). The original Cisterna technology was developed by as a self-build package by a building worker with help from university researchers. The university input was advice over materials and techniques that ensured the water collected was potable and remained in good quality. One might imagine that a standard system design could easily be diffused as an affordable product; but Cisterna retains its self-build aspect in order to construct links in the community and initiates wider processes that give Cistern its social technology characteristics. This not only allows appropriate adaptation, but seeks to empower people too. The water subsequently 'belongs' to the self-builder community, not to a purchaser of a commodity technology; nor is it dependent upon the patronage of local political elites. The hope from social technology advocates is that Cisterna inspires attempts to enhane community resilience further through future social technology projects in the locality (interview, RTS secretariat, 19/11/2010).

That, at least, is the claim for social technology: bringing experimentation and empowerment together. And yet, some organisations, especially R&D organisations with a long trajectory in field extension, can find it difficult to shed institutionally embedded approaches to developing the 'right technology' to solve particular social problems. As our second example illustrates, older field extension perspectives can transfer the 'appropriate' technology to the community quite late; and only then does it become apparent that some of those communities experience the problems, and the intended technological solution, quite differently.

The experience with the Pro-Huerta programme at Instituto Nacional de Tecnología Agropecuaria (INTA, National Institute of Agricultural Technology) in Argentina illustrates

the adjustments involved when conventional technology institutes engage with technologies for social inclusion. Pro-Huerta involves the development of small-scale farming techniques at INTA based on the principles of agro-ecology. The programme has built-up capabilities amongst poorer, subsistence farmers along with the provision of key inputs like seeds, garden tools and small farm animals. According to INTA, the Pro-Huerta programme has helped approximately 3 million people in 600 thousand family farms and small co-operatives in Argentina.

An important feature of the Pro-Huerta programme is its attempt to complement the provision of agricultural input materials with training courses in techniques for developing a small, agro-ecological farm. Inputs to implement the small farm were originally designed and selected by INTA technicians with little participation from the intended beneficiaries. However, the cultural and agronomic diversity of local situations across the extensive geography of Argentina meant the standard package encountered problems. For example, some seeds failed to develop, and sometimes the selection of vegetables did not match local diet. Due to these difficulties, some local INTA technicians and users began making improvements that include participatory schemes, adapted seeds, special tools, etc. This has now been systematized and incorporated by INTA into Pro-Huerta. Pro-Huerta is generally regarded as a successful social technology, and has become emblematic for the major social programs of public R&D institutes like INTA (Montaña, 2010).

The third example is the Social Habitat project led by Paula Peyloubet and her team at the Centre for Advanced Studies at the University of Córdoba in Argentina. Her group aims at the co-construction of technologies for social housing involving occupants and housing institutions at the local level. The Córdoba group has been working for several years in the region of Entre Rios in Argentina, developing wood construction techniques for houses in Villa Paranacito and now in the city of Concordia (Fenoglio & Fressoli, 2012). The aim is to build-up community based capabilities and to encourage the local production of solutions. This avoids starting with prior design solutions for assumed or received problems in housing, but, on the contrary, the process focuses in building up the social and technical aspects of the problem along with the community. As such, one of the central tasks of this approach is to generate a local network of institutions and social actors which defines together which kind of materials, designs and what form of production is appropriate to solve the problem as they have identified it. Thus, they do not provide the solution in the form of a house design, but rather a process of learning and associations embedded in the development of prototype houses. If the network becomes strong enough and the actors learn through the process, they themselves should start to produce their own materials and designs in order to build more appropriate houses for marginalised households. A related aim is to encourage social entrepreneurship and the formation of local markets for the housing capabilities developed.

The main difficulty that the Córdoba group faces is the small scale of its activities and its lack of a systematic methodology. They also rely upon quite simple technological solutions, like using and adapting local wood or experimenting with simple housing designs. Since building up the problem always implies attending to local situations and conditions it seems difficult to translate this approach to a large scale programme (see later).

The Cisterna, Pro-Huerta and Social Habitat examples illustrate different practices in technologies for social inclusion, and that one recognises in many grassroots innovation projects around the world. Some social technology activists are pushing further and see in these practices the potential for much more socially just forms of knowledge production (Dagnino, 2009). In deliberately requiring local innovative effort, more radical social

technology activists envisage solidarity being built and communities thereby empowered. These activists are trying to use grassroots innovation as a focus for mobilising resources and opportunities for purposeful social change. Their goals include forging links with movements for alternative, solidarity-based economies, and with movements for the democratisation of science and technology (see Singer & Portella Kruppa; 2004, Alves da Silva & Sardá de Faria; 2010).

Under the radical view, technologies for social inclusion aspire to be a catalyst for social development in a broader and more mobilising sense than learning-based approaches for embedding technologies in specific project developments (Douthwaite, 2002, Korten, 1980, Clark, 1995). The partnerships that are formed are not only about making sure immediate solutions are locally fitting. Learning to work with neighbours, university researchers, civil society organisations, funders, technology suppliers, politicians, and so on, is intended to deepen *and extend* community capabilities to organise around other issues, to develop and exploit political and economic opportunities, and to enrol others and mobilise their resources. Included in this is an aspiration for communities, embodied in the social technology movement, to influence local, regional and national innovation agendas.

However, attempts to link both to the mainstream innovation community and to solidarity economy movements remain embryonic. The more radical view of social technologies in Brazil sits in an uneasy relationship with some of the corporate and state support for social technology projects and programmes on specific topics. Despite the presence of the Brazilian innovation agency (FINEP) and the Ministry of Science and Technology in the RTS Co-ordinating Committee, for example, efforts to enrol research and development institutions and universities into the network remain limited. Around 110 of the participating organisations are engaged in R&D activities, and around half of these (53) involve research teams from universities. This suggests indifference or even resistance from the wider scientific community. In a similar fashion, whilst the Ministry of Science and Technology contributes funds to RTS, this comes through a specific secretariat for Social Development (Fonseca, 2009). Support does not translate into inputs flowing in the opposite direction, and using RTS experience to open up mainstream science and technology agendas and policies for critical discussion and reform.

Official interest in technologies for social inclusion is emerging in Argentina too; where over 60 organisations are engaged in grassroots innovations[6]. In response to this activity, a number of state bodies have begun to consider the role of technologies for social inclusion as a key area for development. These include the Instituto Nacional de Tecnología Agropecuaria (National Institute of Agricultural Technology, INTA), the Instituto Nacional de Tecnología Industrial (National Institute of Industrial Technology, INTI), and the Programa Consejo de la Demanda de Actores Sociales (the Advisory Program of Demands of Social Actors, PROCODAS) at the Ministry of Science, Technology and Productive Innovation. As with Brazil, however, it remains unclear whether technologies for social inclusion will transcend their status as a social development programme on the margins of science and technology policy.

[6] Based on findings from the research project: "Technologies for social inclusion and public policies in Latin America", International Development Research Centre (IDRC) GAPI-Unicamp. Brazil and IESCT-UNQ-Argentina.

In sum, technologies for social inclusion are a manifestation of a grassroots approach to innovation. Within the broad orientation and principles of this movement, however, participants frame the specific practices and purposes of technologies for social inclusion differently. Some projects and databases consider social technologies to be embodied in technological objects, and whose affordable, small-scale, adaptable characteristics render them available and therefore inclusive to poorer communities through social programmes. Others frame technologies for social inclusion to include intensive processes of participation by user communities in the design, ownership and benefits of technology development, and it is the local-level socio-technical configuration that counts. Here the value of technologies for social inclusion is not limited to immediate project benefits, but rather the empowering impulse it gives to participation in subsequent activities, and that thereby lead to wider social transformation locally. A further, still more radical framing sees technologies for social inclusion as a cipher for the re-orientation of mainstream innovation agendas and economic development.

These different framings of technologies for social inclusion, whether as objects in social programmes, local transformation processes, or pushing against the structures of mainstream innovation policy, are reminiscent of debates within the appropriate technology movement. As we shall see later, they also suggest technologies for social inclusion will need to learn to live with a number of dilemmas, and in so doing will produce a variety of knowledge of potential value to innovation policy debates.

3 The appropriate technology movement

Many of the visions, principles and strategies for social technologies are reminiscent of an earlier generation of appropriate technology. Whilst the contexts and times are quite different, some of the fundamentals endure precisely because they share similar visions and principles. Recalling the appropriate technology movement and ‘thinking with history’ (Tosh, 2008, Bayly et al., 2011) will allow us to identify enduring dilemmas in section four of relevance to social technologies today.

Originating in debates about developing countries and development assistance in the 1960s, and remaining identifiable as a broadly coherent movement until the early 1980s, appropriate technology activists sought to redefine technology as a tool for development. As with social technologies today, the actors and institutions that were part of the appropriate technology movement were varied. They drew in many from the emerging development community and professions, ranging from local activists, donors, extension workers, education institutes, policy-makers, engineers, and (to a much lesser extent) firms. Each brought different perspectives to the basic goals of appropriate technology, including various focal definitions and terms – which included intermediate technologies, alternative technologies, radical technologies, village technologies, community technologies, soft technologies, etc - and a variety of specific approaches to their operationalisation.

Whilst the umbrella term ‘appropriate technology’ was always contested terrain within the movement, some argued it was nevertheless possible to identify a set of common characteristics for these technologies for development: low in capital cost; use local materials; create jobs, employing local skills and labour; small enough in scale to be affordable for small groups; understood, controlled and maintained by local people wherever possible, without requiring a high level of Western-style education; suppose some forms of collective use and collaboration; avoid patents and property rights, etc (see Darrow & Pam; 1978). In essence, appropriate technology was searching for a more situated and socially just

set of principles for diverse technology choices by involving local communities (Kaplinsky, 1990, Willoughby, 1990).

The basic principle was to try and help people develop out of the situations they were in, by providing technologies appropriate to those situations, but which afforded some improvement in the users' economic and social circumstances. In particular, activists targeted small rural communities, since there lived a majority of the poor under significant inequality (McRobie, 1981); but also because it was assumed that rural sites presented situations where appropriate technological approaches were most amenable, compared to the complex situations of development in urban contexts.

An inspiration for activists in the appropriate technology movement was the economist Fritz Schumacher. One of the main worries of Schumacher was to avoid a two sector economy. According to Schumacher, attempts within developing economies to catch up with developed countries by making technological leaps risked creating more poverty and unemployment. Instead of looking to acquire labour-saving, high technology enclaves, poor countries should take a middle path consisting in the selection of intermediate technologies that would free people from poverty and drudgery, yet still provide meaningful work (Schumacher, 1973).

Whilst this smacked of 'second-class' development for elites in developing countries (Willoughby, 1990), including scientific communities (Dickson, 1974), Schumacher's views, along with related arguments by Ivan Illich (Illich, 1973), the Dag Hammerskjald Foundation (Dag Hamaarskjöld Foundation, 1975), and others, resonated with the frustrations many development workers in the field had with post-War industrialisation blueprints (Rist, 2011). Appropriate technology was a reaction against perceived failures in industrial development initiatives in poor countries, in which wholly inappropriate technologies were imported into contexts where they were ill-suited, ended up lying idle for lack of supportive supplies, infrastructure, and skills. The appropriate technology movement repeatedly cited notorious cases of large-scale, expensive and ultimately poorly chosen technologies that had failed to induce the development processes anticipated in the planners' blueprints and theories (Carr, 1985).[7]

The Intermediate Technology Development Group (ITDG), founded by Schumacher and colleagues in England in 1966, was a pioneer institution in addressing the need to pursue appropriate technologies based in a different strategy towards development. ITDG acted as an international hub for other institutions concerned with similar problems. Among the main tasks that the ITDG followed were surveys of existing technologies, the coordination of R&D institutions in several partnerships, consulting and offering advice to communities and other institutions around the world, and advocating for appropriate technology principles (Willoughby, 1990).

A 1979 survey by the OECD Development Centre found 388 organisations from 79 countries were active in AT (Jequier, 1979). A follow-up study in 1984 identified around 1000

[7] Actually, even advocates of the industrialisation strategy were, over time, identifying the gradual build-up of indigenous innovation capabilities as essential, but with a different kind of development in mind (Bell and Pavitt, 1993; Cimoli *et al*, 2009). However, the merits of different sides in development debates is not our concern here, where it is sufficient to point out how and why appropriate technology activists saw themselves as pursuing a different kind of technological innovation.

organisations (in 90 countries) (Jequier and Blanc, 1984). Just Faaland, President of the Development Centre, wrote how AT 'was no longer the preserve of small marginal groups but had become a major preoccupation of national science and technology policy institutions, governmental research centres and private industrial firms' (preface to Jéquier & Blanc, 1984). In Nepal, Papua New Guinea, Botswana, India, Pakistan, Colombia and other countries, appropriate technology centres received support from the state (Whitecombe and Carr, 1982). International institutions like the Inter-American Bank of Development, The World Bank, the UN Environmental Programme, the International Labour Organization, the Food and Agriculture Organization, World Health Organization, the OECD, and UNIDO also established departments of appropriate technologies. Over this period, the plethora of programmes, projects and interests supporting *The World of Appropriate Technology* (as the OECD reported in 1982) appeared substantial (Jéquier, 1982).

And yet, despite this build-up of interest and momentum, this was precisely the moment when the appropriate technology movement peaked. Funding programmes were gradually cut, centres closed, and official development attention moved away to other matters over the course of the 1980s. A few groups remain, including Practical Action, which is a descendent of ITDG. Moreover, some of the context-sensitive principles underpinning appropriate technology have become more central to development assistance and practice generally (Pieterse, 1998). Having contributed to criticism of blueprint developmentalism, and thereby informed revisions in development practice, appropriate technology as a specific object of concern and strategy had ceased to require special pleading.

However, the decline of appropriate technology was not entirely due to its successful diffusion into everyday development practices. On the contrary, there proved to be significant problems in the approach.

The main problem was that innovators became almost exclusively oriented towards specific artefact solutions (i.e. technologies). A focus on technology artefacts had the advantages of becoming amenable to explanation in construction handbooks and field-guides, and therefore seemed sensible for the purposes of widespread diffusion. However, listing and advocating appropriate technologies as a turnkey solution to generic problems of rural poverty tended to eclipse important local development contexts and goals. Assumptions about appropriateness could quickly turn into constraints for further development (small scale, low capital investment, simple design). Appropriate technology artefacts consequently struggled to move local innovation dynamics beyond the solution of basic needs and specific production problems, and to induce a longer term strategy of social and technological capabilities at the local level.

Moreover, it was unclear to what extent appropriate technology centres lived up to the emerging vision of broadening participation in the design and implementation of technology development initiatives. Whilst appropriate technology principles suggested it was open to user-led participation, in practice artefacts sometimes appeared developed by well-intentioned engineers first and foremost, who made all sorts of assumptions about what users needed, and then found, rather like early versions of the Pro-Huerta initiative, that their problem framing was misguided when the artefact was taken to the field. In finding the 'right' artefact, designers relied upon low tech artefacts and in scaling down mature technologies with only limited local participation.

What was required were innovations in participatory processes themselves, and whose careful design could then lead to effective participation by the marginalised in technology

development. This required skill, humility and time on the part of the appropriate technologist (Chambers, 1997). More significantly, it involved working in situations where local power relations sometimes acted against participation, and where access by the very poorest to an appropriate technology would only happen if the local situation was transformed. Small-scale biogas generators developed originally with intensive in-kind support from poor villagers in India, for example, have developed into products sold to wealthier farmers (Romijn et al., 2010).

Finally, appropriate technology innovation processes were dependent upon state and donor funds. It proved extremely difficult to develop autonomous spaces of production, distribution and consumption, including markets (Abrol, 2005). Even if those technologies (effectively capital goods technologies) helped users participate better in self-provision or sales of processed goods to local markets, the effective demand for the technologies remained low. Compounding this issue, appropriate technology initiatives struggled sometimes to tap into existing entrepreneurship capabilities locally, nor inculcate latent or new ones.

As official development policies within international institutions moved increasingly towards neo-liberal approaches, so appropriate technologies relying upon aid and charity, and motivated by wider social values or goals compared to profitable potential, were cast aside. As Kaplinksy reflects: “By the end of the 1970s ... concerns with technological choice and the generation of technology were muted as low income countries grappled with Structural Adjustment agendas and integration into the globalising economy, often seeking to replicate the successful experience of the East Asian newly industrialising economies” (2010: 4). Development activists and fieldworker attention had to re-orientate to this new context.

Nevertheless, the appropriate technology movement had given impetus to ideas about technology whose subsequently quiet, often hidden, re-development over the years is visible in sustainable innovations today. Whether in housing, energy, food processing, mobility, light manufacturing and other domains, many products that are now finding their way into markets (e.g. near the bottom-of-the-pyramid) have some of their roots in grassroots innovation activities (Kaplinsky, 2010). Moreover, processes for public participation and the inclusion of local knowledge, made so apparent by appropriate technology principles, have become common practice in good development projects (Pieterse, 1998, Chambers, 2005).

So whilst appropriate technology as a category slipped away from the development agenda, the movement activists, fieldworkers, and development professionals dispersed into multiple new development debates, agendas and currents of funding. What we see with technologies for social inclusion today, and with contemporary grassroots innovation movements elsewhere, is a re-coalescing of ideas for inclusive technology as a tool for social development. Obviously, this arises under new circumstances and in very different contexts. Nevertheless, some fundamental dilemmas endure.

4 Three enduring dilemmas in grassroots innovation movements

Comparing sections two and three we see family resemblances in the aims, principles and organisation of social technologies now and attempts at appropriate technology in the past. Networking between organisations is common to both, and their development as a social movement. More importantly though, and given these similarities, experience with appropriate technology suggest a number of critical issues relevant to technologies for social

inclusion, and which we argue here are actually enduring dilemmas arising from the shared principles of all grassroots innovation movements.

Movement activists struggled between recognising that appropriate technology was a *process* for focusing locally sensitive development, and yet wanting to popularise and diffuse technology *objects* of wide-scale relevance to poorer communities generally. Practitioners also struggled to address and transform local situations of inequality whose resolution was necessary in order that their technologies would be appropriate to the poor rather than appropriated by local elites. Finally, our account of the appropriate technology movement revealed how dependent it was upon outside support in the form of donor aid, and how market opportunities for appropriate technology struggled in the face of structural readjustment and neo-liberal development ideology.

The issues above are enduring dilemmas because they derive from the principles and approaches common to the appropriate technology movement and the technologies for social inclusion. A focus upon local sensitivity, reliance upon bottom-up activity, and faith in practical rather than political problem-solving means grassroots innovation movements will always have to learn to live with three enduring dilemmas:

1. attending to local specificities whilst simultaneously seeking wide-scale diffusion and influence,

2. being appropriate to existing situations that one ultimately seeks to transform, and

3. working with project-based solutions to goals (of social justice) that fundamentally require structural change

We consider each of these dilemmas below.

Locally-specific yet widely-applicable

The experience of the appropriate technology movement proved in a very practical way that working technologies are socially constructed.[8] As de Laet and Mol (2000) demonstrate in explaining the success of the Zimbabwe water pump, the working of a specific technology cannot be fully comprehended in technical terms alone. Issues like local beliefs, values and religions, idiosyncratic forms of organization and cooperation, and the political significance attributed to certain practices may improve technologies that resonate with these issues, or condemn them to not working where the artefact and wider social world do not easily align.

The appropriate technology movement recognised this challenge, which is why they sought technologies that worked with the grain of localities. And yet, the localities of the poor and marginalised are very diverse. Converting the general principles of appropriateness into finer grained procedures for the design, development and use of technologies requires good local knowledge and adaptable technological forms to fit the specific contexts revealed by local knowledge. The challenge becomes one of developing *socio-technical* configurations (cf. technologies) appropriate to the aspirations, values and situations at play in different local contexts, e.g. the capabilities and resources available, the realities of everyday livelihoods there, as well as the production and maintenance requirements for the artefacts involved.

Such local-scale appropriateness can work against desires for wide-scale diffusion. The ability for appropriate technologies to spread across diverse localities can be undermined by the need to be locally appropriate to each setting. There is a dilemma between locally

[8] Formative experience with grassroots innovation movements, particularly alternative technology in Europe and the United States, influenced more theoretically inclined insights in the emerging field of science and technology studies (Bijker, 1995: 4).

appropriate socio-technical configuration, and standard technologies that seek to be widely applicable. Both the appropriate technology and technologies for social inclusion movements have developed technologies that they believe overcome this dilemma and are appropriable to the diverse settings of the poor and marginalised. Support and effort is nevertheless required each time to ensure those processes of re-application and marketing actually domesticate the technology into a working socio-technical configuration in each location.

Appropriate to, yet transforming situations

There is an added complication. The 'reality' of the situation on the ground is open to interpretation and contestation. Local power relations can assert some realities over others. The local setting and backdrop in which socio-technical configuration takes place might not be appropriate to the most disadvantaged people in that locality. So, for example, a small-scale hydro project works on local hydrological terms, and even in terms of quantities of electricity generated; but if it does not attend also to the institutions that set local riparian rights and govern infrastructures for distributing the electricity, then the development benefits risk accruing to local elites rather than the poor.

If social justice is more central to the innovation process, then grassroots attention to local participation and social control implies an emphasis in justice that recognises the perspectives of the poor and marginalised and is procedurally fair towards them. However, grassroots initiatives often arise in contexts and because of situations that are unjust in terms of the distribution of resources. They tend not to have access to sympathetic knowledge and R&D institutions, nor resources, nor infrastructures, nor the full range of capabilities that would help their grassroots innovative activity flourish. Grassroots innovations that are trying to be socially just tend to be struggling within situations of injustice. In effect, grassroots innovations need to be *inappropriate* in the short-term, in order that they might induce changes that make them appropriate to a more just future.

Providing technological solutions for social inclusion consequently entails accompanying processes for empowering hitherto excluded local actors, recreating networks of solidarity and self-organization, and strengthening the community in order that the technological intervention has the development consequences hoped for. So the dilemma for grassroots innovations movements is that one seeks locally appropriate innovations at the same time as needing to transform the local situation in order that the innovation process and outcomes are socially just.

Project-based solutions yet seeking structural change

The biggest challenge for grassroots innovation movements is that their programmes and projects seek to internalise more socially just principles without really attending to the wider social structures that are the root cause of injustices.

As an example, a difficulty for grassroots movements relates to the bases upon which their projects are judged or evaluated. It is already apparent that assessing failure or success exclusively in terms of the working of the artefact could be problematic. This is because what makes the artefact work effectively in the current situation is different to how it is envisaged as working in the future, better-developed situation. Ideally, grassroots innovations would be evaluated in terms of how much they contribute to transforming the local situation in socially progressive ways. But these longer-term aspirations might sit uneasily with how the

innovation performs in the short-term in relation to the situation prevailing in the present. Without strategies for addressing the broader structural changes that would make pro-poor innovation more viable, then grassroots innovations are always going to struggle. The dilemma for project- and programme-basis of much grassroots innovation is to address structural issues of the economy, knowledge production, and political power beyond the agency of those programmes, and perhaps even beyond the agency of the wider movement.

Another example of structural disadvantage is the mismatch between grassroots innovation and conventional, more powerful innovation systems. Conventional indicators of innovation outputs, such as patents, publications, sales, and so forth, simply do not correspond with grassroots innovations. Patents and other measures for licensing intellectual property, for example, contradict the aspirations of grassroots innovations for more open-source forms of innovation and knowledge sharing (see, for example, the Honey Bee Network in India). Even well-meaning researchers in academic institutes may struggle to provide support for grassroots innovations if the institutional measures of esteem and performance at their universities do not recognise work with poorer communities on 'low-tech' or 'scientifically uninteresting' solutions. Finally, the public resources devoted to conventional innovation in the form of research platforms, incubators, hubs, training of technicians and so forth eclipses the resources available to the grassroots.

Grassroots innovation movements have also to address the structuring effect of market-based development approaches. The appropriate technology movement was unable to thrive after the withdrawal of aid and public development funding, and we see that technologies for social inclusion today receive significant support from governments and foundations. A big contextual difference now has been the rise of social entrepreneurship practices advocating the importance of markets in development (London and Hart, 2011). Under this view, and evident amongst some groups in the movement, technologies for social inclusion becomes the innovation of marketable cheaper products, processes and services affordable to the poor (Kaplinsky, 2010). Even if provided by new small-enterprises and co-operatives which retain business benefits locally, the emphasis is nevertheless upon marketability rather than social transformation. The risk is that deeper, more radical aspects of a grassroots innovation process become lost, such as participation in and control over key decisions, or the aspirations for empowering communities that is more demanding, time-consuming and beyond the reach of monetary valuation and appropriation (Smith, 2007).

5 Knowledge production in grassroots innovation movements

Some analysts and commentators will foresee weakness and failure for technologies for social inclusion given the enduring dilemmas identified above (Beckerman, 1996, Sandbach, 1980, Long and Oleson, 1980). Critics will dismiss the admittedly compromised, necessarily pragmatic, and undeniably partial innovation successes arising from grassroots movements: either because the results are insufficiently radical for social transformation; or because weaknesses confirm views that the ecological modernisation of conventional industrialisation is the only credible path.[9]

We think such dismissal is too hasty. Responses to each dilemma within the technologies for social inclusion movement, for example, will spur the creation of particular forms of knowledge, and which is of value to debates over innovation policy in Latin America. Constructive engagement between technologies for social inclusion and more mainstream

[9] Though the 'green economy', like any vision and set of principles, contains dilemmas and failings too.

innovation policy debates requires frameworks for capturing and understanding the knowledge being produced, and strategies for ensuring that knowledge feeds into debates effectively. This has to be done with great sensitivity and appreciation towards the worlds of grassroots innovation movements, since imposing too prescriptive and rigid a framework, based, say, in the kind of existing institutions and metrics for innovation mentioned above, risks both distorting and bracketing out inconvenient forms of knowledge.

With sensitivities in mind, we elaborate four framings of knowledge production in grassroots innovation movements. We think they are sufficiently broad and empathetic towards technologies for social inclusion because they arise from the dilemmas identified in section four. As such, knowledge is produced through: coping strategies; visionary vanguards; R&D labs for utopia; and reflexive plurality. Each framing emphasises different forms of knowledge and, in the round, indicates how technologies for social inclusion can be appreciated as an experimental space valuable to innovation policy debates.

Coping strategies

An emphasis in the first dilemma, about the possibilities and difficulties for wide-scale yet locally sensitive approaches to inclusive innovation, sensitises observers to the local coping strategies of social technologists. Some local participants are not very interested in wide-scale relevance of the sort sought either by (inter)national donors interested 'scaling-up' solutions, or movement activists interested in social transformation. Local participants are concerned with solutions that cope better with the circumstances of their local communities (Bhaduri and Kumar, 2011). Technologies for social inclusion within this framing reveal the needs of people excluded from mainstream economic activity and create fixes for immediate problems.

If these coping strategies generate wider-relevance, then it is in two senses. First, there might be transferable knowledge about how *processes* for incorporating local knowledge and emphasising the situations of the poor could be designed into other innovation processes. Second, there will be knowledge about which aspects of the social technology are more or less strongly embedded and embodied in the local situation. Such knowledge can be used to generate more place-sensitive information about technologies for social inclusion and their transferability. The knowledge can also inform social entrepreneurship and product development of more widely marketable technologies (Gupta et al., 2003, Kaplinsky, 1990, London and Hart, 2011).

Viewed in this way, the kinds of knowledge emphasised in a coping strategy framing is *ethnographic* in character. They relate to the needs unmet by markets and states, the livelihood conditions of the poor under this absence, the kinds of pragmatic, locally sensitive solutions that can improve their circumstances, and the aspects of a technology for social inclusion appropriable to diffusion programmes and social entrepreneurship.

Visionary Vanguards

Attention to the second dilemma, which concerns the prospects for grassroots innovations to transform local situations, tends to frame technologies for social inclusion as a visionary vanguard for more socially just and environmentally sustainable technological futures. At the core of the social technologies being developed are quite distinct visions for the roles played

by technologies in changed societies, and the processes by which practitioners try to realise these visions.

Whilst having flaws and limitations, the innovations developed in social technology networks nevertheless anticipate a more socially just and environmentally sustainable kind of innovation system. Under this framing, these initiatives are construed as a vital force for citizen-led responses to the challenges of sustainable development: their practical initiatives provide material and discursive resources for future solidarity economies (Dagnino, 2009, Seyfang, 2009, Abrol, 2005, Hess, 2007).

As such, the visionary vanguard framing is interested in quite *instrumental* knowledge about how to develop more socially just socio-technical configurations. Any practical difficulty with the viability of a social technology indicates the additional socio-technical elements, such as capabilities and resources, production and maintenance facilities, and so on, that are required to make the overall configuration work. Knowledge about these requirements, generated through the partial successes and failures of technology for social inclusion initiatives, can inform demands for institutionalisation reforms.

R&D lab for utopia

The third dilemma for grassroots innovation movements challenges the facility with which technologies for social inclusion can induce wider structural changes. Faced with dominant economic and social structures, the efforts of activists are easily criticised for being excessively optimistic and failing to attend to the deeper causes of the problems they seek to address (Dickson, 1974, Rybczynski, 1980). Supportive networks and programmes tend to disseminate know-how, information and publicity (sharing instrumental knowledge), but rarely amount to political programmes for mobilisation and institutional reform. Wide-scale influence is impossible and social technologies are doomed to remain in the R&D labs for utopia.

Others, however, interpret these difficulties as providing an important source of critique of incumbent innovation institutions and regimes of production and consumption (Waks, 1993, Darnovsky, 1991). By trying to do things really differently, activists make very real and very visible the institutional, political and economic injustices of conventional systems (Geoghegan, 1987, Gibson-Graham, 2008, Harvey, 2000).

Under this framing, demanding the impossible is considered quite reasonable precisely because it reveals the institutional reforms required, the infrastructure provision that is needed, and the economic and political restructuring that would make socially just innovation widely viable. That the technologies for social inclusion movement lacks the power to instigate these structural changes is beside the point: rather, it creates the critical knowledge about structural issues, and that can inform and illustrate more precisely the claims for socio-economic and socio-political change made by wider, more empowered social movements, such as solidarity economy activism.

Reflexive pluralities

The final framing of technology for social inclusion knowledge production is to observe the movement as constituting ‘experimental spaces’ for exploring a bottom-up form of socially just and environmentally sustainable technological futures. This framing really works across the knowledges emphasised in the preceding framings, and as such identifies with all three

grassroots innovation dilemmas. Within these spaces, ethnographic knowledge is being created about the diversity of development situations and the coping strategies being developed, some potentially workable solutions and instrumental knowledge for the roles of technologies in more progressive futures, and, finally, these spaces also generate critical knowledge about limitations of the grassroots innovation approaches like the technologies for social inclusion movement. This framing does not look to technologies for social inclusion as providing blueprints or models for development programmes (as the framings above might). Rather, these experimental spaces are considered as contributing a reflexive plurality to thinking about technological futures and social change: because these spaces contest mainstream innovation, and because they widen the adaptable ideas and pragmatic solutions available to the wider social world of innovation (Smith, 2007).

Drawing upon this framing requires analysts and practitioners to look beyond specific social technology projects. The aim is to consider whether and how local projects network, ideas diffuse, and movements for grassroots innovation operate; and reflect upon the diverse insights provided by these experimental spaces. This framing is also interested in whether these insights can be translated into other settings. This not only includes technical support activities such as mentoring, financing, partnering, and advice on business models; but also advocacy roles that seek to make the contexts for technology for social inclusion more favourable, such as developing social economies, linking grassroots knowledge with scientific and technological knowledge, introducing new forms of knowledge democracy, opening up innovation policy institutions, and linking to social movements campaigning for more socially just political economies.

Translating the first three frames of learning in order to build up reflexive pluralities might not be an easy task. Grassroots innovation movements may need to engage further with academics, policy makers, funders and especially local beneficiaries. They will also need to put into question known and tested practices and strategies in order to overcome the dilemmas they face. Given their continuous fragility as social movements, they will have to create stronger socio-technical alliances which could include practices and allies not always wanted. However, that is a key challenge for grassroots innovation movements if they want to have broader participation in the agenda of innovation and development.

6 Conclusions

The purpose of this paper has been to suggest how grassroots innovation movements can be considered sites for knowledge production of relevance for technological forecasting and social change. Our argument was built up through an introduction to technologies for social inclusion movement in Latin America, and given some historical depth through comparison with the appropriate technology movement. Three dilemmas were identified and, we argue, arise from the common principles of grassroots innovation movements. These were:

1. attending to local specificities whilst simultaneously seeking wide-scale diffusion and influence,
2. being appropriate to existing situations that one ultimately seeks to transform, and
3. working with project-based solutions to goals (of social justice) that fundamentally require structural change

These dilemmas indicate how grassroots innovations can be framed in four different ways, and that each emphasises different forms of knowledge production: whether as coping strategies for the poor, visionary vanguards for socially inclusive innovation; a utopian exercise in R&D; or considered as creating and opening experimental spaces for socially just innovation. Grassroots innovation movements are of great potential to innovation policy debates about sustainability. That potential is summarised in table 1.

Within and across each of our frames, the knowledge produced will be contested. The politics involved is beyond the scope in this paper (Leach et al., 2005), but is the focus of ongoing research by the authors. Our purpose here has simply been to map out the diverse forms of knowledge arising from grassroots innovation movements, and suggest a framework for better appreciating its potential contributions to deliberations over innovation policy.

Table 1: Grassroots Innovation Dilemmas, Framings and Knowledge Production

Grassroots innovation dilemma	**Framing of grassroots innovation**	**Forms of knowledge emphasised**
Locally-specific yet widely-applicable	*Coping strategies:* Grassroots coping for absence of provision through existing market and state processes (Kaplinsky, 2010; Gupta et al, 2003; Bhadurai and Kumar, 2010)	*Ethnographic*: - Needs unmet by markets and states - Livelihood conditions and responses - Pragmatic sustainability improvements - Augmentation opportunities for bottom-up solutions
Appropriate to transformed situations	*Visionary vanguard:* Pioneering socially just and environmentally sustainable economies and societies (Seyfang, 2009; Dagnino, 2009; Abrol, 2005)	*Instrumental*: - Socio-technical practices under different value systems - Capabilities and resources required - Economic, social and environmental performance and feasibility under different contexts - Production and maintenance requirements - Advocate and participant perspectives – materiality of radical sustainability discourses
Project-based solutions seeking structural change	*R&D lab for utopia:* Naive R&D lab for utopia – flawed without a political programme targeting structural change (Dickson, 1974; Rybczynski, 1980)	*Critical*: - Institutional misfit (and their reform) - Lack of infrastructure (and provision - material and social) - Economic (re-)structures, lack of capital and markets - Political context (opposing powers, targets and allies)
Experimental spaces relevant to socio-technical	*Reflexive pluralities:* Source of experimental plurality	*Reflexive*: - Spaces for socio-technical experimentation and social learning

foresight	in debates and practices in innovation policy (Irwin et al, 1994; Smith, 2007; Gibson-Graham, 2008)	- Replicable, adaptable and scalable innovations - Manifestation of alternate agendas for innovation policy - Indicators of institutional challenges for sustainability - Empowering by linking to broader social movements

Any encounter between grassroots innovation and mainstream innovation will clearly present challenges to both sides. In order to win some of the mainstream over to the approaches of grassroots innovation, advocates will have to prove their worth on conventional terms of innovation policy; when ideally they wish to change those terms. Mainstream innovation policy actors will have to let go of certain agendas and resources, in order to open up and transform the directions of experimentation. Are ideas for socially just innovation emanating from the 'experimental spaces' of grassroots innovation movements sufficient for mainstream innovation regimes to accept a redistribution and opening up of agendas and policy procedures? Meaningful dialogue requires the identification of common ground. It is unclear currently just how broad that ground is.

Any encounter will put pressure into its practices and bonds with communities and beneficiaries. Thus, framing grassroots innovation movements as an 'experimental spaces' has to remember that inherent to innovation are risks of failure as well as success. Of course, many poor people live with uncertainties every day, and are forced to take risks and improvise simply to survive. Grassroots innovation movements, and an innovation policy attentive to these movements, needs to ensure poorer communities are involved in solutions that improve their livelihoods, and not merely welcoming them as participants in social learning processes benefitting others.

Yet, the development of a broader power base for grassroots innovation could also mean re-defining it in ways that lose sight of its more radical roots, and the radical routes to democratising technological change processes. Entrepreneurial elements of a grassroots innovation might get selected and emphasised that fit easiest into the prevailing market structures. The more transformational package becomes lost. The holistic, local food economy visions of the early organic food movement, for example, or the autonomous, green housing systems from the green building movement, are being incorporated as some limited elements in essentially unchanged, globalising food and housing systems – ingredients for higher-value products without synthetic chemicals, or higher-insulation rates in resource-intense housing (Smith, 2006 & 2007).

Some will view mainstreaming grassroots innovations through their commercialisation as corrupting and co-opting without really improving the economic position of the pioneers. Others will see this as a sign of innovation success. These appropriations, which adapt to contexts rather than transform them, pose dilemmas for the original grassroots movements and for the ethics of learning from them. There are clearly issues of cognitive justice here (Visvanathan, 2005), as well as procedural justice. Reactions to mainstream appropriations such as this can spur some activists towards reinvigorated and refocused searches for more socially just alternatives with the grassroots. Our point is that this kind of dialectic is an important source of reflexivity in the development of societies and economies, and should be

valued as such (Pieterse, 1998). Socially just innovation may not emerge in the forms envisaged by grassroots innovation movements, but the original purposes concerning inclusive development need to be kept in view by anyone interested in more democratic forms of technological change not just for the poor, but also for everyone.

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