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Grassroots innovation movements: challenges and contributions

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ABSTRACT

Technologies for social inclusion in Latin America are a recent manifestation of grassroots innovation movements whose global activities go back to appropriate technology in the 1970s and earlier. Common to these movements is a vision for innovation processes more inclusive towards local communities in terms of knowledge, processes and outcomes. A comparison in this article between movements for technologies for social inclusion now and appropriate technology in the past reveals three enduring challenges for grassroots innovation: attending to local specificities whilst simultaneously seeking wide-scale diffusion; being appropriate to existing situations that one ultimately seeks to transform; and, working with project-based solutions to goals (of social justice) whose root causes rest in structures of economic and political power. Each challenge effectively frames grassroots innovation differently, and responses generate valuable forms of knowledge production: grassroots ingenuity; grassroots empowerment; and structural critique. Overall, these movements contribute valuable plurality and reflexivity to innovation policy and politics.

1. Introduction

Grassroots innovation movements seek innovation processes that are socially inclusive towards local communities in terms of the knowledge, 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).

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).

We include in grassroots innovation movements people and organisations coming from outside local communities, such as engineers and designers, but who engage the grassroots in innovation processes in their ideas from the outset, and put local knowledge and communities in the lead in the framing of a collaborative innovation activity. This is a broader definition compared to that used by others, such as Anil Gupta and the Honey Bee Network, which focuses on the local processes generating individual artefacts, and seeks processes for helping these inventors to develop their ideas and, if desired, diffuse their innovations. In this more circumscribed view, grassroots innovation movements should start form the inside and move outwards (from grassroots ingenuity to wider-scale assistance and diffusion), whereas the broader view includes movements from the outside moving inwards to mobilise and empower grassroots innovation[2] (Gupta et al., 2003; Bell, 1979).

Grassroots innovations rarely feature in the foresight exercises and innovation policies of formal scientific, technology and innovation communities. 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, innovation policy aims are expressed as an imperative to catch-up with or keep-up with an apparently universal techno-economic frontier, currently based in information-, bio-, and

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[2] In practice, movements often combine in both directions. For a discussion see the Spotlight on Grassroots Innovation in SciDev.net (http://www.scidev.net/en/science-and-innovation-policy/supporting-grassroots-innovation/features/supporting-grassroots-innovation-facts-and-figures-1.html).

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nano-technology (Freeman, 1992; Perez, 1983; Bell and Pavitt, 1993).

Grassroots innovation movements, in contrast, arise in reaction to perceived social injustices and environmental problems often arising in conventional innovation models. It is no coincidence, for instance, that the resurgence of Brazilian and Indian[3] economic development in recent years – and the persistence of structural inequality – has been accompanied by calls for patterns of innovation and development appropriate for those left behind in those countries (Dagnino, 2009; Abrol, 2005; Gupta et al., 2003).[4]

Analysts have argued elsewhere that technological controversies constitute informal forms of technology assessment, in the sense that the very different framings of the technology being protested and debated can generate knowledge about the technology useful to policy-makers and investors. Social learning can be enhanced when controversies are viewed and engaged in a technology assessment light (Rip, 1986; Woodhouse et al., 2002; Jamison, 2002; Waks, 1993). We argue that grassroots innovation movements should be taken seriously in a similar vein (Smith, 2005, 2007): grassroots innovation activities and challenges generate knowledge highly relevant to policy for sustainable innovation, where sustainability is understood after Brundtland to mean socially just and environmentally sustainable development (World Commission on Environment and Development, 1987).

Whilst relations with mainstream innovation policy will always be difficult, and whose politics we do not go into in this paper, grassroots innovation movements nevertheless constitute innovative spaces that can enhance the plurality and reflexivity of innovation policy. At a time when innovation policies are increasingly called upon to address issues of poverty, social inclusion and sustainability, 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 (Demeritt et al., 2011; Jamison, 2002; Hess, 2007).

By definition, grassroots *innovations* for, say, locally-appropriate house construction techniques for the urban poor in Argentina are very different to, say, 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, regarding local inclusion and control in processes of technology development and innovative social organisation. Shared principles suggest all grassroots innovation movements confront similar fundamental challenges, even though manifesting in particular ways in contrasting settings.

In this paper we compare recent experiences with technologies for social inclusion in Latin America with those for appropriate technology in the 1970s. The appropriate technology movement aimed to use technology development as a tool for broader social and economic development goals. These goals were considered to rest in technologies that were accessible and beneficial to the poor in terms such as, using local materials, building upon local skills and knowledge, creating and enhancing jobs rather than destroying them, and open to maintenance and control by users. The current movement promoting technologies for social inclusion in Latin America shares similar aims, in the sense that their technology development projects are intended to be inclusive towards the poor, and act as a catalyst or tool for generating broader development benefits. Community energy projects, agro-ecological farming initiatives, locally-organised housing developments, village and neighbourhood materials recycling and local remanufacture, and community-led water and sanitation projects are typical examples.

Our purpose with this comparison is to identify enduring challenges confronting grassroots innovation movements that can form the basis of a framework for understanding their knowledge producing contributions to deliberating sustainability pathways. Whilst the contexts and times are quite different, some of the fundamentals endure precisely because these movements share similar visions and principles. Methodologically we adopt a retrospective analytical approach, whereby recalling and contextualising the appropriate technology movement and 'thinking with history' sensitises us to challenges confronting grassroots innovation movements today (Tosh, 2008; Bayly et al., 2005). As such, our work draws upon the archives and literature associated with appropriate technology, including references to studies by others; in-depth interviews with practitioners of appropriate technology; and more recent fieldwork analysing technologies for social inclusion, case studies of specific projects and visits to them in the field, organising workshops, and in-depth interviews with representatives of support organisations and networks.

The paper is structured as follows. Section 2 discusses a recent movement for technologies for social inclusion in Brazil and Argentina. We provide some historical perspective in Section 3 by recalling the experience of the appropriate technology movement in the 1970s. Common to both movements are three fundamental challenges, elaborated in Section 4. We suggest in Section 5 that, in learning to live with these challenges, grassroots innovation movements generate valuable ethnographic, instrumental and critical knowledge. Taken together, these challenges and knowledges constitute important innovation spaces for sustainability and social justice, and of potential value for innovation policy, even if engaging mainstream policy-makers with the grassroots remains far from easy.

2. Technologies for social inclusion in Latin America

There have been various levels of grassroots innovation activity in Latin America going back to appropriate technologies in the 1970s, but also intersecting with broader movements for democratisation in the region. These strands coalesced in the 2000s into a reinvigorated movement for technologies for social inclusion. Actors involved in this process included local communities, public institutions, R&D laboratories, universities, NGOs, cooperatives and factories reclaimed by their workers. Interest in grassroots innovation ranged from dedicated networks in Brazil, to the cooperative movement in Uruguay, and R&D extension units in Argentina, as well as corresponding approaches active in the region, like agro-ecology and solidarity economy. For the sake of simplicity we group these movement activities under the umbrella label of 'technologies for social inclusion'.

One of the most important and articulated movements over this period has been the Social Technology Network in Brazil (RTS, *Rede de Tecnologia Social*). RTS emerged through long-standing discussions and debates about technology, development and social inclusion in the country, with a formal network dedicated to 'social technologies' created in 2005. Over 900 organizations joined RTS, including non-governmental organisations, universities, private firms and state organisations from both Brazil and other Latin America countries.

The origin of RTS has to be seen in the context of the civil society activism and social movements around the Worker's Party in Brazil, and that finally propelled leader Luis Inácio Lula da Silva into

[3] In China too, there is revived interest in grassroots innovation. Segments of wealthier societies too, confronting their environmental legacy, have seen grassroots innovation movements for sustainability (Seyfang and Smith, 2007).

[4] Conventional innovation agendas are also normative, but this is often left implicit.

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government in 2003. Networks are beginning to appear in other countries, such as Argentina, and where the politics has also shifted favourably. There are also individual organisations and initiatives using similar ideas and terminology. In this sense, the RTS 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 wide-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. In its purest form, this kind of grassroots innovation is really about supporting local ingenuity and innovativeness, as espoused by the Honey Bee Network in India for example. However, RTS and others take a broader view in which developers coming from outside work closely with local communities in order to develop technologies specifically configured for the needs of those communities. As we shall see, these different views can sit uneasily together. More entrepreneurial perspectives, that view locally invented social technologies as requiring support for the diffusion of spin-off products through markets can, for example, imply quite distinct strategies to a local empowerment perspective that sees technology projects as seeding progressive social transformations in communities.

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 2005–2009 state and corporate organisations invested US$175 million in social technology activities (Miranda et al., 2011). However, beyond reliance upon funding from these sources, the links to the science, technology and innovation community in Brazil are weak (see below). Officials see social technology as a social programme rather than innovation policy (Fonseca and Serafim, 2009): something we argue is incredibly limited.

The catalyst for a formal network in Brazil derived from a Social Technology Prize organised by Fundação Banco do Brasil in 2001. The annual prize accumulated a database of entrants and award-winning projects (further augmented by the RTS). Since then, social technologies have been identified, catalogued and promoted in the areas of agro-ecology, recycling, sustainable energy, housing and infrastructure, and rainwater harvesting. The provision of training programmes and funds for the incubation of small-scale, co-operative enterprises aims to support the marketing of social technologies. However, other network participants (including members of the RTS Executive Secretariat) envisage social technologies as a much wider project for social transformation. "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).

Given this background, it is unsurprising that the principles are interpreted and put into practice in different ways, as the following three examples of technologies for social inclusion illustrate.

Cisterna has been a major social technology 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 rainwater harvesting has reached over seven thousand families in 247 municipalities in the region (RTS, 2011). Cisterna was developed as a self-build construction package for families by a building worker with help from university researchers. The university provided advice over materials and techniques that ensured the water collected was potable and remained in good quality. 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 initiate wider processes in the hope that wider social technology goals might be realised.[6] 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 elites. The hope from social technology advocates is that Cisterna nurtures generic development capabilities for further social technology projects that deepen community resilience (interview, RTS secretariat, 19/11/2010; for similar ideas, see Fernández-Baldor et al., 2012).

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 generic technology solutions to solve particular social problems. As our second example illustrates, older field extension habits still seek to transfer the 'appropriate' technology to the community; and only then does it become apparent that some of those communities experience the intended technological solution quite differently, and problematically, compared to field-extension worker expectations.

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 involved the development of small-scale agro-ecology techniques at INTA. 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. 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 small, agro-

[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).

[6] Indeed, moves to import water tanks and other inappropriate technology components, at the same time as cutting funds for the programme, led to popular protests to reinstate the original social technology programme.

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ecological farming livelihoods. According to INTA, the Pro-Huerta programme has helped approximately 3 million people in 600 thousand family farms and small co-operatives in Argentina.

However, the programme did not start out like that. Inputs to implement the small farm were originally designed and selected by INTA technicians at the centre with little participation from the intended beneficiaries. When taken to the field, the cultural and agronomic diversity of situations across the extensive geography of Argentina meant the standard package encountered problems. Some seeds failed to develop, for example, and the selection of produce did not match local diet. Due to these difficulties, some *local* INTA technicians and users began innovating improvements that include participatory design, adapted seeds, special tools, etc. In other words, the initial technology extension programme was opened up to adaptation through grassroots innovation. This proved so effective that it was incorporated by INTA into Pro-Huerta. The programme is generally regarded as a successful example of social technology, and has become emblematic for the social programs of public R&D institutes (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 and Fressoli, in press).

Forestry materials and skills in the region are being adapted to local housing requirements. The aim is to build-up community based capabilities and to encourage the local production of housing solutions, compared to reliance upon federal programmes for social housing to centralised designs with little local input or benefit beyond shelter. The Social Habitat approach avoids starting with prior design solutions for assumed or received problems in housing. On the contrary, the process focuses in building up the social and technical aspects of the problem with the community. As such, one of the co-design tasks of this approach is to generate a local network of institutions and actors who define together which materials, production techniques, and socio-economic organisation is appropriate to solve the housing problem as they have identified it.

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.

However, the Cordoba team's provision of learning processes and production embedded in the development of prototype houses fails to articulate with social housing funders who expect standard, proven house designs. The main difficulty that the Córdoba group faces is the small-scale of its activities and its lack of a systematic methodology. They 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 housing programme without changes to the wider housing institutions (see later).

All three examples illustrate different practices in technologies for social inclusion. 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 building and mobilising resources, capabilities and opportunities for local transformation. Their strategies for this include forging links with wider movements for solidarity-based economies and the democratisation of science and technology (Singer and Portella Kruppa, 2004; Alves da Silva and Sardá de Faria, 2011).

As such, 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 cf. Fernández-Baldor et al., 2012).

The partnerships that are formed are not only making sure immediate solutions are locally fitting, but actually transforming local contexts. 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. The more radical social technology activities envisage such processes recalibrating national innovation policies towards more inclusive 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 flows in the opposite direction, whereby RTS experience is used to open up and influence mainstream science and technology agendas and policies.

More recently (as we write in 2012), the RTS strategy is being reconsidered by its main founder and funder, Banco do Brasil. New proposals focus on centres of demonstration of social technology artefacts around Brazil, and the creation of a forum for policy support at Ministerial level. Although too soon to tell, these proposals suggest a move to a more isolated programme of pro-poor technologies, compared to earlier attempts to engage mainstream S&T agendas in grassroots innovation and social transformation.

In comparison, in Argentina over 100 organisations are promoting grassroots innovations (Thomas and Fressoli, 2011).

In response, 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. In 2011, these institutions along with the University of Quilmes and the NGOs Agua y Juventud, ICECOOP and Plurales Fundacion created the Technologies for Social Inclusion Network – Argentina (Red TSIA). Red TSIA now has the support from over 60 social organizations.[7] As in Brazil, however, these

[7] See www.redtisa.org.

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developments have not proceeded smoothly in Argentina. A recent programme on social technologies implemented by the Instituto Nacional de Tecnología Industrial (National Institute of Industrial Technology, INTI) was cancelled due to changes in authority, for example. Networks remain thin and the resilience of movement networks uncertain.

These recent experiences indicate some limitations of grassroots innovation initiatives when reliant upon marginal public support and corporate social responsibility. The difficulties of engaging with mainstream S&T institutions are also apparent (see later). It remains unclear whether technologies for social inclusion in the region will transcend their status as a social development programme on the margins of innovation policy.

Meanwhile, the broad principles continue to be framed differently and generate diverse practices in social technology projects. Some consider social technologies to be embodied in artefacts, and whose affordable, small-scale, adaptable characteristics render them available and therefore inclusive to local communities. Ideally, the technologies derive from or build upon the local ingenuity of the communities involved, as was the lesson with Pro-Huerta. Indeed, other projects frame technologies for social inclusion to include intensive processes of participation by grassroots communities in the design, ownership and benefits of technology development. It is the local-level socio-technical configuring that counts more than specific artefacts. By extension, the value of technologies for social inclusion is not limited to immediate project benefits, but rather the empowering impulse and capabilities generated for participation in subsequent activities and social transformations. A further, still more radical framing sees technologies for social inclusion as a cipher for the re-orientation of mainstream innovation policy towards grassroots innovation.

These different framings of technologies for social inclusion, whether as the appropriate choice of artefacts in social programmes, nurturing local ingenuity, empowering local transformation processes, or pushing against the structures of mainstream innovation policy, are all reminiscent of debates within the appropriate technology movement. As we shall see later, they also suggest three enduring challenges for grassroots innovation.

3. The appropriate technology movement

Originating in debates about development assistance in the 1960s, and remaining identifiable as a distinct 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 involved were varied. They drew in many from the emerging development professions, ranging from local activists, donors, extension workers, education institutes, policy-makers, engineers, and (to a much lesser extent) firms. Each brought particular perspectives to the basic aims, including various focal definitions and terms like intermediate technologies, alternative technologies, radical technologies, village technologies, community technologies, soft technologies, etc.

Whilst the umbrella term ‘appropriate technology’ was always contested terrain, 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 (Darrow and Pam, 1978).

In essence, appropriate technology was searching for a more situated and socially just set of principles for diverse technology choices by considering conditions in 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. Activists tended to target small rural communities (though not exclusively), 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.

Prominent in the appropriate technology movement was the economist Fritz Schumacher. 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 high technology enclaves and a two tier economy, developing 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 to critics (Willoughby, 1990), including scientific communities (Dickson, 1974), Schumacher’s views (and related arguments by Illich (1973), the 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 reacting against wholly inappropriate technologies imported into contexts where they ended up idle for lack of supportive supplies, infrastructure, and skills. The movement repeatedly cited notorious (even corrupt) cases of large-scale, expensive and ultimately poorly chosen technologies that failed to induce the development processes anticipated in the planners’ blueprints and theories (Carr, 1985).[8]

The Intermediate Technology Development Group (ITDG), founded by Schumacher and colleagues in 1966, pioneered the pursuit of appropriate technologies. ITDG acted as an international hub for networks of institutions concerned with similar issues. Among network activities were surveys of technologies, the coordination of R&D partnerships, consulting and advice to communities, donors and development fieldworkers, and advocacy work (Willoughby, 1990).

A 1979 survey by the OECD Development Centre identified 388 organisations from 79 countries active in appropriate technology (Jéquier, 1979). The Centre listed 1000 organisations in 90 countries in 1984 (Jéquier and Blanc, 1984). Just Faaland, President of the Centre, wrote how appropriate technology ‘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’ (Jéquier and 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

[8] 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).

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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 movement peaked. Funding programmes were cut, centres closed, and official development attention moved away to other matters over the course of the 1980s. A few groups survived, including Practical Action (the 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 due entirely to diffusion into everyday development activity. On the contrary, there were persistent problems to the approach in practice. The main problematic tendency was for innovators to become almost exclusively oriented towards generic, turnkey technological solutions. Whilst this was advantageous for inclusion in appropriate technology handbooks and field-guides, and seemed sensible for the purposes of widespread diffusion, it tended to eclipse critical local development contexts and goals. Assumptions about appropriateness (small scale, low capital investment, simple design) could quickly turn into constraints for further development. Appropriate technologies consequently struggled to induce broader innovation dynamics and capabilities beyond the solution of basic needs and specific production problems.

Ironically, even appropriate technology centres were challenged by the emerging vision of broadening participation in the design and innovation of (technology) development initiatives. Whilst appropriate technology principles suggested it was open to user-led participation and grassroots innovation, in practice activity tended to be control by well-intentioned engineers first and foremost, and their assumptions about what users needed. Rather like early versions of the Pro-Huerta initiative, appropriate technologists found their problem framing was misguided when the artefact was taken to the field. In that sense, the grassroots innovativeness of appropriate technologies was lost since in this form it neither engaged with local ingenuity nor empowered locally communities.

Required were innovations in participatory processes themselves, and whose careful design could then lead to effective participation by those hitherto marginalised in technology development. This needed skill, humility and time on the part of the appropriate technologist (Chambers, 1997).

More significantly, it involved addressing situations where local power relations, whether of gender, class, age or ethnicity, acted against participation, and where access by the poorest or marginalised would only be meaningful if the local situation was transformed politically. For example, small-scale biogas generators developed in India originally with participation from poor villagers, and thanks to donor aid, were later developed into products sold to wealthier farmers (Romijn et al., 2010).

Appropriate technology initiatives found it difficult to transcend dependency upon state and donor funds. Developing autonomous spaces for appropriate technologies proved elusive (Abrol, 2005). Even if the technologies (effectively capital goods) helped users participate better in marketing goods locally, it rarely overcame the structural poverty inhibiting effective market demand for the technologies themselves. Compounding this issue, appropriate technologies sometimes struggled to tap into or inculcate local entrepreneurship capabilities.

As development policies within international institutions moved increasingly towards neo-liberal approaches, so appropriate technologies relying upon aid and charity, and motivated by non-market goals, were cast aside. As Kaplinksy (2010: 4) 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".

Development activists and fieldworker attention had to reorientate to this new context. As appropriate technology as a category slipped away from the development agenda, movement activists, fieldworkers, and development professionals dispersed into multiple new development debates, agendas and currents of funding.

Nevertheless, the appropriate technology movement had raised ideas about technology whose subsequently quiet, often hidden, influence over the years has become visible in sustainable innovations today. Whether in housing, energy, food processing, mobility, light manufacturing or other domains, innovations that are now finding their niche have roots in appropriate technology (Kaplinsky, 2010; Smith, 2007). Moreover, processes for public participation and the inclusion of local knowledge, made so apparent (positively and negatively) by appropriate technology, have become common practice in good development projects (Pieterse, 1998; Chambers, 1997).

What we see with technologies for social inclusion today, and with contemporary grassroots innovation movements elsewhere, is a re-coalescing of ideas for inclusive innovation as a tool for social development. Obviously, this arises under new circumstances and in very different contexts. Nevertheless, some fundamental challenges reminiscent with appropriate technology endure.

4. Three enduring challenges in grassroots innovation movements

Comparing Sections 2 and 3 we see family resemblances in the aims, principles and organisation of social technologies now and attempts at appropriate technology in the past. Importantly, experience with appropriate technology helps us think about challenges confronting technologies for social inclusion today.

Movement activists struggled between recognising that appropriate technology was a *process* for focussing and supporting grassroots ingenuity and context sensitive solutions, and yet wanting to popularise and diffuse technology *objects* of wide-scale relevance to poorer communities generally. Moreover, even when developing technologies appropriate to immediate contexts, practitioners struggled to induce deeper and wider transformation processes for removing poverty. Finally, our history of the appropriate technology movement revealed risky reliance upon outside support, in the form of donor aid, in the face of structural readjustment and neo-liberal development ideology.

These are enduring challenges because they derive from the principles and approaches common to the appropriate technology movement and 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 challenges:

Attending to local specificities whilst simultaneously seeking wide-scale diffusion and influence,
Being appropriate to existing situations that one ultimately seeks to transform, and

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

We elaborate each below.

4.1. Locally-specific, yet widely-applicable

The experience of the appropriate technology movement proved in a very practical way that working technologies are socially constructed.[9] 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. Characteristics like local beliefs, values, forms of organization and cooperation, and the political significance attributed to certain practices may improve technologies that resonate with these characteristics, or condemn them to not working where the technology and 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 political and economic realities of everyday livelihoods there, as well as the functional requirements for the technologies involved.

Local-scale appropriateness works 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 challenge between locally appropriate socio-technical configuration, and standard technologies that seek to be widely applicable. Ideas about 'replication' processes cited in the case of the RTS suggest activists believe they can overcome this challenge. Support and effort is nevertheless required each time to ensure re-application really domesticates the technology into a working socio-technical configuration in each location.

4.2. Appropriate to, yet transforming situations

There is an added complication. The 'reality' of the facts on the ground is always open to interpretation and contestation. Local power relations can assert some realities over others, such that socio-technical configuration departs from forms fully appropriate to the most disadvantaged people in a 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. Reforming such rights might simply be off limits for the agenda of a technology project; designing the required institutions, infrastructures, or capabilities beyond participants.

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 not only of resources but also political power. 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. The challenge 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 outcomes are just.

4.3. 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.

Without strategies for addressing the broader structural changes that would make these innovations more viable, then grassroots innovations are always going to struggle. The challenge for project- and programme-bases 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 grassroots innovation movement.

An example of structural disadvantage is the mismatch between grassroots innovation and conventional 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, sit uneasily with the aspirations of (some) grassroots innovations for more open-source forms of innovation and knowledge sharing (see, for example, the Honey Bee Network and National Innovation Foundation in India). The development of a consistent set of credible indicators, that allows evidence about the benefits (and limitations) of grassroots innovation to accumulate, is required before innovation policy makes significant commitments (Bell and Letty, 2012).

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. Even committed researchers in local universities and academies may struggle to provide support for grassroots innovations if the institutional measures of esteem and performance do not recognise 'community' work on 'low-tech' or 'scientifically uninteresting' solutions.

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 in the case of the RTS that technologies for social inclusion today receive support from governments and foundations with strings attached. A big difference nowadays is the rise of social entrepreneurship (London and Hart, 2011).

Under this view, and evident amongst some grassroots innovators, technologies for social inclusion becomes the innovation of cheaper products, processes and services marketable to the poor (Kaplinsky, 2010). Even if provided by enterprises that retain business benefits locally, the emphasis is nevertheless upon

[9] Formative experience with appropriate technology, particularly in Europe and the United States, influenced constructivist theorisation in the emerging field of science and technology studies (Bijker, 1995).

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marketability rather than social transformation. The risk is that the deeper, more radical aspects of a grassroots innovation process become lost, such as public participation in and control over key decisions, or the aspirations for empowering communities. Both of these are elude monetary valuation and appropriation (Smith, 2007).

5. Knowledge production in grassroots innovation movements

One could easily dismiss technologies for social inclusion given the enduring challenges identified above (Beckerman, 2005; Sandbach, 1980; Long and Oleson, 1980).

Critics emphasise 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 conventional industrialisation is the only credible path. Such dismissal is too hasty. Responses to each challenge by grassroots innovation movements create forms of knowledge of considerable social value in debates about innovation policy.

Constructive engagement between technologies for social inclusion and more mainstream 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 sensitivity, 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 grassroots knowledge.

With sensitivities in mind, we elaborate three framings of knowledge production on the basis of the challenges identified above. These framings are grassroots ingenuity, empowering inclusion, and structural critique. We think they are sufficiently broad and empathetic precisely because they arise from the challenges (see Table 1).

Each framing emphasises different forms of knowledge and, in the round, indicates how technologies for social inclusion can be appreciated as constituting an innovative space valuable to innovation policy debates (Section 5.4).

5.1. Grassroots ingenuity

Responses to the first challenge, about the possibilities for wide-scale yet ingenuity. Here it is important to bear in mind that local participants are not always very interested in wide-scale relevance of the sort sought either by (inter-)national donors seeking 'scaled-up' solutions, nor movement activists envisaging social transformation. Participants can be more concerned with devising ingenious local solutions that cope better with their immediate circumstances, and where markets and state currently fail to provide (Bhaduri and Kumar, 2011).

Grassroots innovation within this framing generates ethnographic knowledge about the lived experiences of people, their indigenous innovation capabilities, and the coping strategies needed for appropriate solutions to immediate problems.

If grassroots ingenuity has wider relevance then it is in two senses. First, there might be transferable knowledge about how *processes* for incorporating local knowledge and emphasising the diverse situations of the grassroots could be designed into other innovation processes. Second, there will be knowledge about which aspects of the grassroots innovation 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. Such knowledge can also inform social entrepreneurship and product development of more widely marketable technologies (Gupta et al., 2003; Kaplinsky, 1990; London and Hart, 2011).

In sum, the kinds of knowledge emphasised in the grassroots ingenuity framing is *ethnographic* in character. It relates to the needs unmet by markets and states, the livelihood conditions of the poor under this absence, local cultures, and the kinds of pragmatic, sensitive solutions that can improve circumstances, as well as the aspects of a technology for social inclusion appropriable to different kinds of diffusion.

5.2. Empowering inclusion

Attention to the second challenge, concerning the prospects for transforming local situations, frames innovation as empowering the grassroots to have great control over their futures. At the core of grassroots innovation are inclusive visions for shaping technologies in changed societies, and the processes by which practitioners try to realise these visions. Whilst having flaws and limitations, these grassroots engagements 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 debate (Dagnino, 2009; Seyfang, 2009; Abrol, 2005; Rybczynski, 1980).

Table 1
Grassroots innovation challenges, framings and knowledge production.

Grassroots innovation challenge	Framing of grassroots innovation	Forms of knowledge emphasised
Locally-specific, yet widely-applicable	*Grassroots ingenuity*: Grassroots creatively coping for local absence of provision through existing market and state processes (Kaplinsky, 2010; Gupta et al., 2003; Bhaduri and Kumar, 2011).	*Ethnographic*: - Needs unmet by markets and states - Livelihood conditions and responses - Pragmatic sustainability improvements - Augmentation opportunities for bottom-up solutions
Appropriate to, yet transforming situations	*Empowering inclusion*: Pioneering socially just and environmentally sustainable economies and societies (Seyfang and Smith, 2007; 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
Project-based solutions, yet seeking structural change	*Structural critique*: By trying to do things very differently, grassroots movements make visible the structural impediments to inclusive innovation (Dickson, 1974; Rybczynski, 1980).	*Critical*: - Institutional misfits - Lack of infrastructure - Economic and political structures - Potential allies and antagonists

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Any practical difficulty with the viability of a social technology indicates the additional material and social elements, such as capabilities and resources, production and maintenance facilities, and so on, 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 wider reforms.

In sum, the empowering inclusion framing is interested in quite *instrumental* knowledge about how to develop more socially just socio-technical configurations.

5.3. Structural critique

The third challenge for grassroots innovation movements relates to 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.

Others, however, interpret these challenges 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 very differently, and in coming from or engaging with the excluded, grassroots innovation movements make very visible the institutional, political and economic injustices of conventional innovation 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 inclusive innovation widely viable at grassroots level. That the technologies for social inclusion movement lacks the power to instigate these structural changes is beside the point: rather, it creates critical knowledge about structural issues that can inform the claims for socio-economic and socio-political change made by wider, more empowered social movements, such as solidarity economy activism.

In sum, the structural critique framing emphasises knowledge production about the structural impediments to grassroots innovation. Such knowledge can become a basis for fine-tuning broader social, political and economic processes for institutional reforms and structural change.

5.4. Spaces for reflexive pluralities

The plural knowledge generated by the three framings of grassroots innovation makes it reasonable to conceive of grassroots innovation movements constituting 'innovation spaces' for bottom-up forms of socially just and environmentally sustainable technological futures. Within these spaces, ethnographic knowledge is being created about the diversity of development situations and grassroots ingenuity, instrumental knowledge about potentially workable solutions that can diffuse and transform contexts, and, finally, critical knowledge about limitations of grassroots innovation movements in isolation.

An innovative spaces approach does not look to the grassroots as providing blueprints or models for development programmes. Rather, these spaces are considered as contributing a reflexive plurality to thinking about technological futures and social change: because grassroots spaces contest mainstream innovation, and because they widen the adaptable ideas and pragmatic solutions available to the wider social world of innovation (Smith, 2007; Gibson-Graham, 2008).

Such a perspective requires analysts and practitioners to look beyond specific grassroots innovation 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 knowledges produced by these innovation spaces, and whether these insights can be translated into other settings or fine-tune broader movements for social change. 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 grassroots innovation 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.

Without a broader power base for grassroots innovation, entrepreneurial elements of a grassroots innovation might get selected and emphasised that fit easiest into prevailing market structures and knowledge institutions. The more transformational package becomes lost. For example, only a few narrow, technical elements from the holistic, local food socio-technical systems of the early organic food movement, or the autonomous, green housing systems from the green building movement, are being incorporated into globalising food and housing systems – ingredients for higher-value products without synthetic chemicals, or higher-insulation rates in otherwise resource-intense housing (Smith, 2005, 2007).

Some will view mainstreaming grassroots innovations through their commercialisation as capture. Others will see this diffusion as a sign of innovation success. These appropriations, which adapt to context rather than transform them, pose dilemmas for 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.

Reaction to mainstream appropriation spurs some grassroots activists towards reinvigorated searches for more socially just alternatives. Thereby generating further knowledge for entrepreneurial appropriation, as well as continued hope for social justice. Our point is that this kind of dialectic is an important source of reflexivity in development, and should be valued as such (Pieterse, 1998). Whilst socially just innovation may not emerge in the forms envisaged by grassroots innovation movements, the original purposes motivating inclusive innovation need to be kept in view.

6. Conclusions

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

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 fundamentally require structural change

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These challenges indicate how grassroots innovations can be framed in different ways, and that each emphasises different forms of knowledge production: whether as grassroots ingenuity; empowering inclusion; or structural critique. These generate important ethnographic, instrumental and critical knowledge for innovation policy-makers, and as such grassroots innovation movements should be valued for the way they constitute more plural and inclusive innovation spaces.

Clearly, the knowledge being produced will be contested. 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. Meanwhile, mainstream innovation policy actors will have to let go of certain agendas and resources and open up to grassroots innovation. The politics involved is beyond the scope of this paper (Leach et al., 2005). Our purpose 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 for innovation policy, and perhaps even re-balancing dialogue with this significantly different innovation space.

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