



Technology for Autonomy and
Resistance: The Appropriate Technology
Movement in South America

Mariano Fressoli and Elisa Arond

Appropriate Technology

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Between the 1970s and 1980s appropriate technology (AT) became a worldwide grassroots innovation movement that sought to redefine technology as a tool for development. In South America, AT emerged in a context of political upheaval between the challenge of political repression and the influence of new forms of activism and participation. The AT movement was able to develop its own local networks, technologies and to re-frame AT ideas in a more suitable way for the needs of the region. At the same time, the AT movement also struggled with scarce funding, lack of interest from scientific institutions and the increasing waning of AT ideas from the international arena. Despite these difficulties the AT movement was able to create an idiosyncratic set of mobilization resources that outlasted the movement itself and later become influential for other grassroots innovation movements in the region, like agroecology and the Social Technology Movement in Brazil. In this paper we analyse the stories of the AT movement in South America by focusing on their frames, spaces and the pathways of alternative development this movement attempted to build.

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Acronyms

AT	Appropriate Technology
CAFOD	Catholic Agency For Overseas Development
CET	Centro de Educación Tecnológica
CETAAR	Centro de Estudios Sobre Tecnologías Apropriadas de la Argentina
CETAL	Centro de Estudios sobre Tecnología Apropiada para América Latina
CETEC/MG	Fundación Centro Tecnológico Minas Gerais
CEUTA	El Centro Uruguayo de Tecnologías Apropriadas
CEVE	Centre of Economic Housing
CIAL	Organisation of Research in Alternative Agriculture
CLADE	Consortio Latinoamericano en Agroecología y Desarrollo (Latin America Consortium of Agroecology and Development)
CNPq	Conselho Nacional de Desenvolvimento Científico e Tecnológico (National Council for Technological and Scientific Development)
CONICET	National Council for Science and Technology
FAO	Food and Agriculture Organization
GATE	German Appropriate Technology Exchange
ILO	Industrialisation through Substitution of Imports
INTA	Instituto Nacional de Tecnología Agropecuaria
ITACAB	Instituto de Transferencia de Tecnologías Apropriadas para Sectores Marginales (Institute for Transfer of Appropriate Technology for Marginal Sectors)
INTEC	Instituto Tecnológico de Chile
ITDG	Intermediate Technology Development Group
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Co-operation and Development
PTTA	Appropriate Technologies Transfer Programme
R&D	Research and Development

RAP-AL	Red de Acción en Plaguicidas y sus Alternativas de América Latina (Pesticide Action Network in Latin America)
STS	Science, Technology and Society
SATIS	Socially Appropriate Technology International Information Services
S&T	Science and Technology
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
USA	United States of America
USAID	United States Agency for International Development
VITA	Volunteers in Technical Assistance (USA)
WWII	World War Two/Second World War
WHO	World Health Organization

Abstract

Between the 1970s and 1980s appropriate technology (AT) became a worldwide grassroots innovation movement that sought to redefine technology as a tool for development. In South America, AT emerged in a context of political upheaval between the challenge of political repression and the influence of new forms of activism and participation. The AT movement was able to develop its own local networks, technologies and to re-frame AT ideas in a more suitable way for the needs of the region. At the same time, the AT movement also struggled with scarce funding, lack of interest from scientific institutions and the increasing waning of AT ideas from the international arena. Despite these difficulties the AT movement was able to create an idiosyncratic set of mobilisation resources that outlasted the movement itself and later became influential for other grassroots innovation movements in the region, like agroecology and the Social Technology Movement in Brazil. In this paper we analyse the stories of the AT movement in South America by focusing on their frames, spaces and the pathways of alternative development this movement attempted to build.

Keywords: Appropriate technology, Latin America, grassroots innovation, social movements, alternative technology, S&T policies.

1. Introduction

Originating in debates about developing countries and development assistance in the 1960s, and remaining identifiable as a broadly coherent movement until the 1980s, appropriate technology practitioners sought to redefine technology as a tool for development. Actors and institutions that were part of the appropriate technology (AT) 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 – and a variety of specific approaches to their implementation.

The umbrella term 'appropriate technology' involved, broadly speaking, a set of common characteristics that attempted to shape technologies for development: low in capital cost; reliant on local materials; job-creating, 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; involving some forms of collective use and collaboration; avoiding patents and property rights; and other similar characteristics (Darrow and Pam 1978). In essence, proponents of appropriate technology sought a more situated, environmentally concerned and socially just set of design and operational principles for diverse technology choices by involving local communities (Kaplinsky 1990; Willoughby 1990).

The basic principle was to try to 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. Appropriate technology was a reaction against wholly blueprint developments involving imported Western technologies, whose industrial contexts were ill-suited to the poor, and ended up lying idle for lack of supportive supplies, infrastructure, and relevant 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). In particular, AT practitioners targeted small rural communities, since there lived a majority of the poor under significant inequality (McRobie 1981).

An important inspiration for practitioners in the appropriate technology movement was the economist Fritz Schumacher, who founded the Intermediate Technology Development Group (ITDG)¹ with colleagues in 1966 in England (Willoughby 1990) and wrote the influential book *Small is Beautiful* (Schumacher 1973). Schumacher's views, along with related arguments by Ivan Illich (Illich 1973), the Dag Hamaarskjöld Foundation (Dag Hamaarskjöld Foundation 1975) and others, resonated with the frustrations many development workers in the field had with post-WWII industrialisation blueprints through North-South technology transfer (Rist 2011).

As the notion of appropriate technology gained recognition (between the 1970s and early 1980s), international institutions such as the Inter-American Development Bank, The World Bank, the United Nations Environment Programme (UNEP), the International Labour Organization (ILO), the Food and Agriculture Organization (FAO), the World Health Organization (WHO), the Organisation for Economic Cooperation and Development (OECD) and the United Nations Industrial Development Organization (UNIDO) established departments of appropriate technologies. Over this period the plethora of

¹ ITDG formally changed its name to Practical Action (<http://practicalaction.org/>) in 2008.

programmes, projects and interests supporting *The World of Appropriate Technology* (as the OECD reported in 1982) were substantial (Jéquier 1982).

AT ideas became more prominent in South America² during the late 1970s and early 1980s, a moment of dramatic social changes including cases of political upheaval and repression, dictatorship and social mobilisation. It was also a moment when the idea of development and the role of the state started to be questioned as endogenous industrialisation (under the state-led Import Substitution model) and social services infrastructure were slowed or even halted in some countries. Furthermore, most South American countries were affected by a debt crisis that provoked economic restructuring and gave way to what was regarded as the lost decade of the region. It was also a decade where ideas for AT were reaching their peak globally and starting to be challenged by the rise of ideas of market-based development and neoliberalism (Pursell 1993; Rist 2011).

Nevertheless, in South America, the appropriate technology vision of self-reliant economic activity through technological autonomy resonated well with practitioners, NGOs and some scientists and scholars of science and technology. But it also attracted suspicion, as it smacked of 'second-class' development for some elites (including scientific communities) (Dickson 1974) and a technologically deterministic theory of development (see Willoughby 1990), which suggested that if the right kind of tools could be developed, then more egalitarian economic and social development would automatically flourish.

Perhaps these prejudices are behind some of the reasons why the history of AT in South America has remained largely untold. Apart from some personal communications and brief mentions there has been almost no reflection on the extension, results and legacy of the AT movement in the region. What literature does exist tends to focus in the theoretical shortcomings of the AT approach (Thomas 2012)³, and has generally overlooked the political and mobilisation aspects of this movement. Many AT centres have closed, and in some cases archives and libraries have been lost, which reinforces both the impression of failure, as well as the difficulties of researching more nuanced genealogies and hopeful consequences of AT activity.

In this paper we look at the appropriate technology movement in South America, exploring the context in which it arose, grew and waned, who was involved, how they conceptualised AT, what strategies they used, types of projects that were experimented, obstacles or dilemmas they faced, and how they tried to overcome these. Finally, we attempt to trace some of the lasting influence they had, or pathways that were constructed. More specifically, our three overarching research questions are:

1. How was the AT movement mobilised in South America? Who were the actors, and what were their visions and frames?
2. How did AT practitioners promote and support socially just and sustainable innovations?⁴

² South America is a complex and diverse region with important differences among its countries (Cardoso and Faletto 2003). To avoid a homogeneous view of the region we have tried to highlight some particularities of each country's historical context in relation to AT experiences. For example, the experience of Colombia in the 1960s and 1970s includes the birth of left-wing rural and urban guerrilla movements and, despite some authoritarian features, contrasts with the notorious right-wing dictatorships of Argentina, Brazil and Chile.

³ We took a similar view in previous studies about AT (Fressoli *et al.* 2011). However, this work was only based on secondary sources. Further studies allow us to challenge the paternalistic view and put that in context.

⁴ Note: The term 'innovation' was rarely used by AT groups in the 1970s and 1980s. However, in this paper we use the terms 'innovation' and 'technology' interchangeably in order to be consistent with the concept of grassroots innovation movements (Fressoli *et al.* 2014).

3. What dilemmas confronted the AT movement in South America as proponents tried to develop alternative pathways for innovation and development?

To answer these questions we draw on interviews in Argentina, Chile and Colombia and a review of primary and secondary sources of information, including archived documents. The text is organised as follows. The next section will focus on the historical background of the AT movement in South America; the third section will explore the framings of AT and how these ideas were translated and reshaped in the region. The fourth section describes the spaces where AT ideas and practices were developed, and the fifth section describes briefly some of the exemplary technologies of the movement. Section six analyses the pathways that AT practitioners attempted to forge in South America, highlighting some of the difficulties and dilemmas they faced. Finally, we conclude with some remarks on the legacy of AT in the region, and its implications for other grassroots innovation movements.

2. Historical Background: Sovereignty, Political Upheaval and Crisis

As in many parts of the world, for South America the 1970s and early 1980s was a dramatic period characterised by revolutionary ideas, the emergence of new social actors, novel political demands and intense contradictions within strategies for development. The influence of Latin American dependency theory (Celso Furtado, Raúl Prebisch - see footnote 9) and interest in economic sovereignty, peasant movements, changing political consciousness within universities, and the 1973 oil crisis, made for a context receptive to ideas about appropriate technology. In the 1970s, the exhaustion of import substitution and increasing political struggle led to political confrontation and violence in many countries. Elites' fear of left-wing movements, political activism, increasing demands from popular sectors, coupled with USA intervention in various countries' national politics exacerbated authoritarian tendencies usually embodied by the military (Collier 1978; Levy 1981). As a result, most South American countries fell under harsh dictatorships that implemented their own systematic plans of economic and social transformation. In some countries, such as Argentina, this meant dismantling or marginalising existing science and technology activities oriented to social development⁵. Alternative visions of the purpose and practice of science and technology among some intellectuals, peasants and students, while often suppressed, were also notable at this time, and were key to the spaces and contexts for AT in the region.⁶

2.1 Dependency theory and Latin American emphasis on economic and technological autonomy⁷

As in other regions, the broader political economic context and institutional developments had been shaping the emergence of formal policy for science and technology in Latin America since World War Two. Such policy, and its consequences, became an important reference point for AT arguments. Formal Science and Technology (S&T) policy in Latin America in the 1950s and 60s was motivated by the view of S&T as an engine of growth, and a desire for modernisation and development, as well as a nationalistic response to recommendations by international institutions, such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) (Dagnino and Thomas, 1999). Influenced by the USA's post-WWII science policy (Bush 1945), many of the national science and technology research councils were established or consolidated in this period in ways that followed a linear model of science pushing development forward (Albornoz 2001). This supply focused approach gave limited attention to links with productive sectors (Dagnino and Thomas, 1999; Herrera 1973; Vessuri 2003). At the same time, research funded by international aid focused mostly on imported technical fixes, not on building longer term technological or innovative capabilities (Herrera 1973; Vessuri 2003).⁸

Some Latin American scholars questioned the international economic model that placed Latin America into a peripheral position, dependent on Northern markets and technologies, a situation maintained

⁵ See (Gárgano 2011).

⁶ Most of Latin America experienced military dictatorships during the 1960s and 1970s. Among others, in 1973 a *coup* took over Uruguay. Pinochet's regime started in Chile the same year. In 1976 a brutal military junta took over power in Argentina. Some years before, in 1964, a dictatorship also suspended democracy in Brazil until the mid-1980s. There were few exceptions, for example: Colombia, Costa Rica, Mexico, and Venezuela.

⁷ This section draws heavily on Section 2.2 of the STEPS Working Paper 48 (Arond *et al.* 2011).

⁸ International institutions and government support to S&T focused largely on technical assistance, exchanges, scholarships and science planning, seeing obstacles to S&T development as cultural and institutional deficiencies. Support tended to be tied to foreign nations' science communities, instead of having a focus on building domestic S&T capabilities and links with the productive sector that could help address domestic problems (Herrera 1973). The Rockefeller Foundation was key in helping to set up national and international agricultural research services in the region aimed at increasing agricultural productivity during this period. However, such efforts were criticised for being based on a Green Revolution model of seeking technological solutions to social problems, tending to favor large and medium-sized producers over smaller-scale farmers, and were often highly centralised bureaucracies (Bebington *et al.* 1993).

through international political-economic and social structures.⁹ These scholars proposed industrialisation through substitution of imports (ISI) as an escape from chronic underdevelopment. Argentina, Brazil and Mexico pioneered ISI, and later Colombia, Chile, Peru, Venezuela, and some Central American countries followed (Albornoz 2001; Vidal and Mari, 2002).¹⁰ Highly influenced by Latin American structural dependency theorists, regional science policy researchers began to question the prevalent model of a science and technology gap to be 'filled' with more resources, training and planning. Instead they asked for a more structural analysis of S&T and called for building domestic capabilities that were more relevant for the region, and connected with production needs, rather than following international scientific scholarship (Herrera 1973).¹¹ In this context, researchers and practitioners of the so-called 'Latin American School of Thought on Science, Technology and Development' emphasised technological autonomy, and local and endogenous technological development as a way to foster an integrated development process attentive to broader sectorial and national policies (Vidal and Mari 2002). Members of this school of thought were particularly interested in linking S&T with the basic needs of socially and economically marginalised groups. They criticised existing Research and Development (R&D) systems for being severely disconnected from social realities in Latin America at the time, and for failing to draw on domestic capabilities, while also calling attention to environmental concerns (Herrera 1973). Amílcar Herrera and Oscar Varsavsky, in particular, called for a science that was committed to addressing pervasive social inequalities.¹² Herrera was an early supporter of AT ideas and became an important influence for some AT practitioners. However, despite this theorising effort, and important influences on policy, mainstream research communities largely remained distanced from social needs in most South American countries (Dagnino and Thomas 1999).

2.2 Politics, economic development and activism in turbulent times

The 1970s and early 1980s was a period of political upheaval and dictatorship that would affect almost every aspect of economic, political and social life in many Latin American countries. Key to understanding the development of AT in the region is an awareness of regional political and economic turmoil. Those countries that didn't have dictatorships were nonetheless experiencing massive political unrest. For instance, in Colombia, where civilian governments continued, the state, with the help of the US Government, nevertheless resorted to violent means to try to repress rural and urban left-wing guerrilla movements, a conflict which persists today, especially in rural areas.

In general political terms, the aim of the various authoritarian regimes was to dismantle the mobilisation capacity of what was called the national-popular alliance based on the working class, students, peasant movements, and other actors.¹³ Together, the economic and political programme of dictatorships

⁹ The structural dependency theorists (e.g. Raúl Prebisch, Carlos Furtado, Osvaldo Sunkel and Pedro Paz) described a situation of 'centre-periphery' relations (i.e. North-South) that led to structural dependency, a pattern established in colonial times. Highly influential in Latin America, Prebisch published *The Economic Development of Latin America and its Principal Problems* in 1950, which proposed what later came to be known as the 'Prebisch-Singer Hypothesis' (Prebisch, 1950).

¹⁰ However, this policy was later contested in some countries by the wave of neo-conservative economic policies and dictatorship (see next section).

¹¹ For example, Herrera (1973) attributed the failure of efforts to build S&T in the region to the, 'erroneous assumptions about the nature of the obstacles [...] determined by structures conditioned by these countries' place in the international system' (Herrera 1973).

¹² For example, 'technology... for what and for whom?' as the first section title in a publication series by the Faculty of Engineering at the Universidad de Los Andes in Bogotá, Colombia, which highlights the unequal effects of technology as a manifestation of cultural alienation, citing Varsavsky (Posada 1974).

¹³ These movements were influenced by many factors, including Marxist tendencies, the liberation theology of the Catholic Church, radical ideas combining popular education and political empowerment by Paolo Freire, community and cooperative development experiences, campesino movements, and debates about agrarian land reform (Bebbington *et al.* 1993: 37).

transformed the structural base of organised mobilisation of the 1960s and 1970s through, 'repression, marginalisation and increasing informality of the economy' (Garretón 2002: 11). As Hirschmann argues:

[...] the major authoritarian wave of the sixties and seventies in Brazil, Chile, Uruguay and Argentina definitely attempted to defuse mass mobilisation and to turn the citizens into very private persons. In principle, the formation of cooperatives and other forms of collective action at the grassroots should therefore be incompatible with the very structural requirements of those authoritarian regimes.

(Hirschmann 1984: 98)

During this period military governments in some countries also severely restricted the possibilities for scientific contribution to social change by closing research centres, especially in universities, through direct political persecution and economic marginalisation of scientists (Herrera 1973; Levy 1981). In individual terms, any political activist became a suspicious person and many activists in Argentina and Chile, for example, went into exile and found refuge in Europe or the USA. In contrast, in Brazil¹⁴ university budgets and student enrolment did not suffer as much as in the rest of South America (Levy 1981).¹⁵ And although some Brazilian scientists were victims of repression, for others the situation was tolerable due to the role and support for science within the strategy of development and technological autonomy of the dictatorship (Dias 2013).

In economic terms, neo-conservative policies sought to end the period of endogenous development through autonomous industrialisation and state regulation (Schamis 2009). Dictatorships also introduced pro-market policies that cut or reduced social welfare programmes, suspended workers' rights, and opened up the economy to imports. As a result, import substitution diminished and imports grew, resulting in increasing unemployment and loss of the industrial workforce (Hirschmann 1986). Finally, Latin American countries accumulated massive foreign debts at the end of the 1970s, which hampered economic growth and political stability during most of the 1980s.¹⁶

Rural economies and the poorest portion of the population were particularly hard hit by the opening of the economy and retreat of the existing welfare state. In countries like Argentina and Chile, state-funded programmes of technical assistance and technology transfer for the rural population were generally cut and dismantled (Gárgano 2011; Gomez and Echenique 1988).

For Argentina, Brazil and Chile, the 1980s made clear the dramatic (and more or less structural) consequences of the dictatorships in terms of demobilisation, deindustrialisation and increasing economic crisis (Cavarozzi 1991), but also highlighted the need to seek new forms of organisation and social work. As the period of more violent repression came to an end and some dictatorships around the region were already showing signs of stagnation and diminishing political support, so civil society organisations and social movements took the opportunity to regroup, though they did so by adopting very different problems and forms of organisation to those in the 1960s and 1970s:

¹⁴ Brazil as an exception also extends to the economic and political aspects of the dictatorship. Brazilian dictatorship arrived earlier - during the bureaucratic authoritarian period - and supported a strong strategy of autonomous development and industrialisation that was not abandoned during the 1970s. As a result, the dictatorship leaned towards increasing political openness during the 1970s (Cavarozzi 1991; Hirschmann 1986).

¹⁵ There were also some exceptions to the military disdain for autonomous science in particularly strategic knowledge fields such as nuclear energy in Argentina and computer science in Brazil (see Adler 1988).

¹⁶ For more details of the crisis of foreign debt and its consequences see Cavarozzi (1991).

When the authoritarian or military regime showed its most foundational [repressive] dimension, social movements diversified into various spheres of society and turned more towards cultural and social problems than to the economy and politics.
(Garretón 2002: 11) (our translation)

Periods of relative political openness allowed social and political activists to come back from long exiles in foreign countries. As they returned, so they brought back new ideas and experiences about technology and politics picked up in exile, which combined with regional ideas which had been repressed during the period of dictatorships. In countries like Colombia that didn't have the same experience of the dictatorships, other types of links and exchanges with international researchers and institutional networks, combined with regional views on endogenous development needs, also shaped interest in AT, and gave opportunities for AT to take root. Some individuals and groups were able to attract support from international aid organisations that, during the 1980s, were keen to shore up development and educational programmes in the region, and which had AT departments interested in similar ideas. In this context of relative openness - between the end of the 1970s and the beginning of the 1980s - and increasing expectations about democracy and development, many AT centres were created in the region. As such, AT developments in the region were forged between regional demands for greater political and economic autonomy, visible in different ways in the dependency school, peasant and student movements, and Northern concepts, imported through international institutions, networks and influences, and which required translation to local opportunities, problems and demands.

The history of AT in South America is rich and diverse, involving various institutional assemblages, areas of interest, technological domains and political goals. Almost every South American country had some AT activity during this period and it is possible to trace AT centres and programmes in Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, Venezuela and Uruguay (see Table 2.1). Apart from a few exceptions (most notably in Brazil) AT centres in the region were autonomous institutions, with a NGO-like status that depended on external funding to carry on their activities. These centres included engineers, economists, sociologists and social workers. In some cases they also included the work of volunteers and students, and had a few links with academic institutions. Importantly, some of the regional social actors and centres of AT were connected to the global AT movement, and acted as a relay between regional developments and international opportunities.

In the following sections we analyse this experience by focusing on the framings, strategies, knowledge and technologies involved and the dilemmas that AT cases developed in Argentina, Chile, Brazil and Colombia.

Table 2.1: *List of AT Organisations/Centres in South America*¹⁷

Name of Centre or Organisation	Location	Year Founded	Exemplary Technologies
Soluciones Prácticas (associated with Practical Action UK)	Peru, but active across Andean region	1985	Housing, agriculture, sustainable livelihoods, water and sanitation, food processing technologies, energy technologies (e.g. micro-hydro)
CEVE - Centre of Economic Housing	Argentina	1973	Affordable housing technologies

¹⁷ This list does not aim to be comprehensive, but highlights an array of institutions we identified as engaged with AT in South America. Reddy (1979: 67–68) highlights some problems with enumerated lists of AT institutions, which include that they are: 1. usually based on explicit declarations of interest in AT, though many institutions may work on AT without using the label, and therefore not identified in AT lists; 2. some institutions may be listed as AT institutions, whereas they do not actually focus on technologies specific to the rural poor, just to rural areas more broadly; 3. the AT movement which sometimes reject mainstream S&T institutions as emphasizing western technology, and therefore exclude themselves from formal lists.

ENDA – Environmental Development Action in the Third World ENDA – Colombia	Colombia, but other national ENDA organizations exist in the region as well	1983	Urban recycling, cooperatives, food security, environmental protection
CETAL - Centro de Estudios sobre Tecnología Apropriada para América Latina	Valparaiso, Chile	1982	Solar collector, compost toilet
Centro de capacitación y experimentación en Tecnología Apropriada – TEKHNE	Santiago, Chile	1983	Rural and water management
Centro de Estudios sobre Tecnologías Apropriadas de Argentina (CETAAR)	Marcos Paz, Argentina	1985	Agroecology, medicinal plants, composting, solar collectors
Centro Científico Tecnológico Barrancas (CECITEB)	Jujuy, Argentina	1982	Agroecology, indigenous knowledge.
Centro Uruguayo de Tecnología Apropriada – CEUTA	Montevideo, Uruguay	1985	Agroecology, solar collectors, Witch cook stove
ITACAB - Instituto de Transferencia de Tecnologías Apropriadas para Sectores Marginales	Based in Lima, Peru, but with links across South America	1986	
Servicios Múltiples de Tecnologías Apropriadas (SEMTA)	La Paz, Bolivia	1980	Agroecology, water recollection
Red Colombiana de Tecnología Apropriada	Bogota, Colombia	~1987	Urban AT Self-construction Technological alternatives to public services
Universidad de Los Andes, Facultad de Ingeniería	Bogota, Colombia	~1974	Cassava processing, health technologies, water filtration, ceramic stove
Centro para la Gestión Tecnológica Popular	Lara, Venezuela		Smokeless stoves, organic compost, sustainable letrines, hydroponic crops
Centro Experimental Gaviotas	Bogota, Colombia Vichada, Colombia	1971	Solar water heater, micro-hydro, small wind turbines, biodiesel generation, agro-forestry
CIAT – Centro Internacional para la Agricultura Tropical Participatory Research in Agriculture Project	Based in Palmira, Colombia. Oriented to tropical countries worldwide	1967, 1984 and 1986 ¹⁸	Cassava processing and preservation technology Local agricultural research committees (CIAL)
Fundación Ecuatoriana de Tecnología Apropriada (FEDETA)	Ecuador	1984	Solar Energy, rural management
Centro de Tecnología Apropriada (CTA), Catholic University	Asunción, Paraguay	1981	Building techniques, Agroecology

Source: elaborated by the authors for this paper

¹⁸ CIAT was established in 1967 with a Green Revolution model. Work with cassava cooperatives in Colombia and Ecuador started in 1984 and farmer-participatory research started in 1986.

3. Framings for Appropriate Technology in Latin America

As AT practitioners started to develop capabilities and technologies in the region, they soon discovered that the AT ideas from Europe and South Asia did not exactly fit the complex reality of South America in the 1980s. Furthermore, AT ideas arrived at a moment when ideas for both political mobilisation and economic development were being questioned and re-designed in the region. So one of the first tasks for AT centres was to translate and reframe AT ideas into terms relevant to local problems, actors and situations. We use the notion of framing (Benford and Snow 2000; Snow *et al.* 1986) in order to understand how AT practitioners and institutions in South America developed specific meanings that allowed them to identify and organise their experiences in forms that helped them to connect to more powerful narratives. The use of this concept will allow us to understand how AT practitioners in the region translated the values, practices and vision of the global AT movement into the realities and needs of South America.

3. 1. Development intervention

A central thread of the AT vision worldwide, which also proved to be key in South America, was the design of technologies for the resolution of immediate needs of the poorest population. Latin America was, and remains, a region of severe socio-economic inequalities (Herrera 1974). Moreover, in the early 1980s, most Latin American countries were suffering a general retreat of state social policies. In this context of increasing inequality across the region, AT centres aimed to provide solutions to urgent problems that the population was facing in terms of food security, energy, healthcare and social housing by developing simple, accessible technologies. The adoption of AT was related to this new social emergency in a context of economic and political crisis. And in some countries like Argentina, Chile and Uruguay, this strategy also fitted well with the need to find forms of engagement amidst the impacts of military rule, demobilisation of earlier social activism and the gradual emergence of new civil society organisations. By promoting simple technologies, AT centres in these contexts found that they could (and needed to) disguise political aims of autonomy and solidarity under the cover of technical assistance.

Development interventions involving AT in the region were widely varied, and included alternative energy generation in rural areas, productive urban communities, livelihood generation, nutrition, food harvesting and processing technologies, water and sanitation among other interventions. These efforts focused on acknowledging and honouring the skills and knowledge of poor and excluded people who were understood to be, 'constantly experimenting and innovating in a struggle to survive' (Gamser *et al.* 1990: 3). AT ideas were also set in response to a sense of failure in attempts at technology transfer projects which ignored local knowledge, needs and constraints, including local politics, and inaccurately characterised poor people as resistant to technical change.¹⁹

¹⁹ For example, in a discussion of adopting solar energy for the Altiplano agriculture in Bolivia, a member of staff from the Servicios Múltiples de Tecnologías Apropriadas highlighted the notion of AT as requiring more than attention to socially just technical components. 'Farmers will be very critical of hardware proffered them by assistance agencies [...] that does not recognise the constraints that govern their agriculture. Non-adoption cannot be taken as a rejection of change; it is merely a rejection of what appears to be the unpractical' (Mercado Rodas, 1989: 11). Similar insights arose from cases in Huancayo, Peru, such as the adoption of tapial, or compressed earth bricks, adapted from its original application in rural areas to construction in urban settings, and water management in the dry Coquimbo region of Chile to meet changing environmental conditions (ITDG 1989: 3).

3.2. Changing social and political consciousness

AT offered a different development path from that of the so-called developed countries, based on a critique of environmental and social problems associated with mass industrialisation. The AT path focused on the unique characteristics and potential of rural areas, especially:

The classic industrialisation of urban emphasis, based in conventional technology, is no longer the only development option. The national objectives no longer should be defined by only the modern sector of the population. Our majority rural population and the extensive peripheral zones can become decisive factors in national well-being ... The more that the characteristics of the man and the region are emphasized, the more importance they acquire in the production of goods and services, based on criteria such as the initial investment, universality of the equipment, use of local materials, simple maintenance, and employment. This is the search for appropriate organizations and technologies.

(Rodriguez and Zapp 1974: 4)

A second aspect of AT's appeal in some national contexts was the need to find new forms of mobilisation, resistance and empowerment in popular sectors. In the face of political violence and economic retreat by the state, and the economic crisis that followed, AT practitioners were required to transform their former political activism into material practices, thereby avoiding confrontational action. This meant moving from the work of political formation to popular resistance and strategies of survival.²⁰ As the Centro de Educación Tecnológica (CET) described, 'there is a need to approach the basic needs of popular sectors, and not only through organisation and social conscience' (CET 1985: 5).

AT interventions in the region were concerned with strategies to foster local and political autonomy among the poorest population and at the same time to develop sustainable technologies. Thus, AT ideas provided a concrete set of tools to intervene and continue former social activism in shantytowns and popular neighbourhoods, although through more concrete means.²¹ There was a sense that, by promoting local capabilities and the ability to solve their own problems, civil society organisations would be able to establish certain autonomy from the state, which in fact did not provide the solutions required. AT groups envisaged a concrete, material technological practice that allowed community development as a way to re-create solidarity bonds, restore lost self-confidence and promote local leadership:

The second element (of the process of intervention) is the development of a conscience that implies the recuperation of their social identity, namely, the sheer comprehension that they are a sector within society, which are their real problems and interests, and how they came to be in the place they are. The reflection about history is one of the important elements for the comprehension of their actual situation.

(CET 1985) (our translation)

²⁰ In the context of dictatorship there were obvious reasons to avoid forms of mass mobilisation and protest against elites, and there AT practices created a convenient cover to do social work while introducing new forms of empowerment. But even at the time of the return of democracy in Argentina and Uruguay AT ideas drew from new strategies of mobilisation, in particular related with NGO practices. In this sense, AT practices can be seen as part of a larger grassroots and cooperative development movement (Hirschmann 1984).

²¹ Authoritarian regimes sometimes tolerated these grassroots movements and organisations (as in Chile and Brazil). As Hirschmann explains, some smaller initiatives were 'considered as 'diversionary' by the Left, so they were welcomed by the new authoritarian regimes as social formations likely to absorb energies that might otherwise take more dangerous forms' (Hirschmann 1984: 99). This aspect was clear in several AT centres in Chile (Serrano, interview). In most cases activities were initiated by former social activists and political exiles. The same idea of intervention was also present in other spaces and had some connections with the social doctrine of the Catholic Church.

Since this work was also based on previous ideas and activities of 'grassroots development', and opposed to top-down development, it shaped a particular political vision of technological grassroots development that highlighted local autonomy and participation.

3.3. From top-down strategies to increasing participation

A common critique of the AT movement points out that, despite claims for local appropriateness, practitioners and engineers nevertheless failed to fully empower beneficiaries because they determined and implemented 'appropriate' technologies in overly rational and paternalistic ways. Local people were studied rather than involved. This criticism often characterises AT as an example of technological determinism.²² Yet one of the most interesting features of AT advocacy in South America is that practitioners also strove to experiment with social participation, enabling communities to define their problems and experiment with their own solutions. This feature should not be surprising since ideas about popular education and participatory methodologies were strong in the region due to the influence of authors like Paulo Freire and Orlando Fals Borda²³ that helped shape new approaches to participation (Kaimowitz 1993). Thus AT often included sociologists and social workers as part of their team. They also devised several methodologies that pointed to (certain processes) of co-design of technologies, a series of feedback loops of information gathering that allowed participants to monitor the work of technologies, and which also lead to self-organisation and construction by users of technologies. In the case of Tekhne, an AT centre in Chile, its method of intervention also differed from pure technology transfer and involved: (a) allowing local communities to express their own needs; (b) including some participants in the development of technologies; (c) taking decisions, together with the community, regarding the adoption of proposed solutions and the necessary steps for implementation; (d) the implementation and process of starting up the technology is done together with the community; along with (e) the tasks of supervision and technical support (Leppe and Velasco 1985).

However, the new approaches did not come easily, and were sometimes adopted as a result of earlier failure with technically-focused AT methodologies. The design of workable methodologies for AT ideas implied a long process of learning by doing. As a former member of CETAL describes:

More than theory, we started to make technologies, real artefacts and then we realized that working with people in the field was indeed more related to social engagement, that you had to include social work. Technological transfer was not possible without social engagement. Then we realized that it was more important to have an organized community than technology, that technology in itself was useless, and therefore that appropriate technology was not correct as definition. That is why we started to call it Socially Appropriate Technologies.
(Serrano 2014)

The process of learning how to do AT in South America became intrinsically related with social participation in the processes of technology development. Furthermore, as practitioners assigned other meanings to AT, such as political resistance to the dictatorship, autonomy or solidarity, so the idea of participation took on deeper and stronger significance. By doing so, the range of practitioners in South America was widened and stretched their own technical rationality (Schon 1983) to include popular participation and appropriation as a core activity of technological development. Furthermore, they

²² For a review of this critique see (Willoughby 1990: 246–251).

²³ Paulo Freire was a highly influential Brazilian scholar and early proponent of critical pedagogy which sought to avoid the universalism of modernity in education and instead called for collective actors (such as students, peasants, indigenous) to participate actively in the co-creation of knowledge through intercultural dialogue, and to appropriate to themselves mainstream culture as a medium to become free subjects. Orlando Fals Borda was an influential Colombian sociologist and founder of participatory action research which called for the political and social responsibility of the researcher, including the participation of both the researcher and the researched in producing new transformative knowledge. Both Freire and Fals Borda contributed significantly to thinking from the perspective of the oppressed or periphery (Freire 1973; Fals Borda 1979).

attempted to translate the AT method into a more political platform of social experimentation and transformation.

Funding institutions did not always understand the extension of this approach. Large international organisations sometimes pushed for a more industrial-focused vision of AT, even questioning the alternative movement as limiting opportunities and interest of national governments because they were associated with the off-beat, counter-culture movement (Reddy, 1979).²⁴ In the case of South America, the main difficulty in dealing with funding institutions was pressure to scale up experiences, a process that could undermine public participation schemes (Serrano, 2014).

As AT centres made a real effort to devise participatory approaches these changes were also noticeable through their own conceptual development. As Serrano describes, during the early 1980s some practitioners started to talk about AT as 'socially appropriable' technologies (Serrano 1985), implying that appropriateness was a social process that had to be constructed during the initiative, rather than an *a priori* definition based on technical requirements. Furthermore, as beneficiaries and local actors started to tinker with appropriate technologies, giving them different uses or replacing original materials, some practitioners also talked about technologies that were 'socially appropriable' and 'appropriated', meaning by this the process of appropriation of its materiality and knowledge and its incorporation to local culture.

Thus, there was an effort to design in participatory schemes, at least in certain phases of technological development. Of course, with hindsight it is possible to see that despite this attempt, AT centres in the region also drew from the traditional use of directories of technologies and static solutions to complex social problems. However, what characterised many nodes of the AT movement in South America was not the latter, but rather the effort to devise distinctive, participatory approaches that used technology as a tool for autonomy and empowerment.

3.4. Traditional knowledge and indigenous communities

Regional re-definitions of AT did not stop at its conceptualisation. The terms for identifying problems, choosing materials, and sources of knowledge were also adapted. In Latin America, and especially in the Andean region, this process of adaptation meant addressing the needs and traditions of indigenous communities, such as the Mapuches in Chile or the Quechuas in Perú.

From its early years, definitions of appropriate technologies in Latin America include references to the importance of local knowledge and available solutions. For example, in a paper originally written in 1979, Manuel Baquedano describes the cultural features of AT, 'Whenever possible, they should try to re-value local culture, by using all the knowledge accumulated by the community throughout its existence' (Baquedano 1985) (our translation).

Furthermore, CETAL in Chile considered indigenous and popular knowledge that could be regarded as socially appropriate technologies to be a source of technological learning:

[...] due to modernization, the influence of other groups or by the evolution of the same group, a lot of these (vernacular technologies) are sometimes discarded or forgotten. When this happens they are lost for culture and leave few remains behind. These technologies might have been discarded since they stopped working or they were lost in a process of transculturation as sometimes happens, for example, with indigenous groups in their struggle with our process of development. However, these technologies could have been useful for the original group as well as

²⁴ '[...]the presence of such 'off-beat' groups often repels conventional institutions which may otherwise have far greater potential for generating and disseminating appropriate technology. Conversely, the appropriate technology 'movement' often tends to exclude established institutions of education, science and technology on the grounds (invariably justified!) that such institutions are predominantly concerned with western technology' (Reddy 1979: 68).

for other groups in similar situations. For this reason the process of retrieving, improving and adapting these technologies is important in order to transform them into something useful for everyone and thus to become part of the cultural archive of humanity.
(Serrano 1985) (our translation)

Therefore, as part of AT tasks and aims there was an element of retrieving and re-valuing popular knowledge and indigenous knowledge, and that appealed to a social memory of technology. By bringing indigenous knowledge into AT workshops, groups of engineers and practitioners attempted to systematise local knowledge, providing it with a certain scientific base. Much of the work of retrieval involved the collection and study of botanical and agricultural knowledge from indigenous communities. They were, in that sense, aligned with another framing close to AT groups in Latin America, agroecology and sustainable development.

One of the more radical approaches was that of Grupo Talpuy in Peru, which started as a traditional AT group offering off-the-shelf technology but which rapidly realised the need to adapt its technologies and communication strategies to the indigenous population through its bilingual (Spanish and Quechua) magazine, *Minka*. *Minka* ran between the early 1980s and the late 1990s. Its contents were selected and developed in collaboration with local communities. For instance, potato pests affecting local farms were described in Quechua and also by their scientific names (Paucar Santana and Zambrano 1991). According to the editors of *Minka*:

Indigenous knowledge can provide the basis for an Andean technology system that allows communities to produce more, at lower cost, without damage to the environment and without external dependency. Modern scientific knowledge has a role to play in this process. The key is to use it to explain and develop Andean's farmers *own* technology. We work to uncover the scientific basis of Andean knowledge, while at the same time popularising other types of scientific knowledge.

(Paucar Santana and Zambrano 1991: 58)

Thus, for *Minka* editors it was not only a matter of modernising indigenous knowledge but also, as the subtitle of the magazine affirmed, aiming at building an 'authentic indigenous science'. For the rest of the AT centres however, the process of retrieving local knowledge was associated with scientific validation in more formal settings like universities and R&D institutions.

3.5 Environmental crisis and alternative development

Concern about the environment and the negative effects of technological development were at the heart of the original vision of AT worldwide and also influenced AT groups in the region. Latin American scientists like the eco-economist Ignacy Sachs in Brazil and the agroecologist Miguel Altieri from Uruguay were important influences in the design of strategies for, respectively, low cost and no-waste technologies and organic agriculture (Kaimowitz 1993).

The diagnosis of the situation included both macro and micro aspects of a crisis in the rural sector. At the macro level, concerns about the social and environmental effects of the Green Revolution and big agriculture pointed to the need to develop alternative, more sustainable methods suitable for small farming. For example, practitioners worried about the strategy of development based on the industrialisation of farms and increased use of inputs (e.g. agrochemicals) that were expensive and were not necessarily produced locally or even nationally, thus increasing foreign dependency and also eliminating jobs.²⁵ Furthermore, the concentration of land ownership accompanying modernisation

²⁵ With reference to Colombia, Posada writes, 'we are already seeing the consequences of the free entry of technology in the agricultural sector with the Green Revolution, which if it isn't carefully controlled produces technological unemployment, concentration of land, and bankruptcy of small farmers, besides the ecological damage associated with the pesticides and disruption of ecological equilibrium by the highly intensive exploitation of soils (Posada 1974: 14).

worsened access to land for small farmers and increased pressure on the environment (Altieri and Yurjevich 1991). Finally, the elimination of public extension activities in the rural sector also took its toll as rural communities were left without technical assistance.²⁶

On the micro level, there were concerns about the marginalisation of the rural population in national development agendas, the increased process of acculturation that resulted from industrialisation of the rural space, and the loss of traditional practices. It was argued that these processes deteriorated the social identity of rural communities and had an impact on its resilience and autonomy.

As a result, there was a real urgency to develop ways to provide training and survival skills to local communities without introducing technologies or knowledge that were foreign to their local customs. Organic farming was in that sense familiar to rural populations that still relied upon traditional methods of cultivation. Agroecological knowledge, complemented with the task of retrieving indigenous technologies and farming practices, provided AT centres with a programme to foster autonomy and self-economic reliance. Organic farming was first and foremost a practice to tackle poverty and produce food with the tools available to the community and that, as a result, promoted sustainable development.

[Agroecology] had the originality that assumed the material restrictions of the small Latin-American farmer and strengthened the available farming knowledge. These offers of development spread rapidly around the region as a new concept of rural development. Due to the existence of a big number of families of farmer background that did not have access to land, this institution [CET] also proceeded to design a programme aimed at family food security that included the semi-urban population. Thus, agroecology - more as a praxis than as a discourse- become an approach sensitive to the complexities of local farming, taking care of its sustainability (biological stability and conservation of resources), and productive efficiency (familiar food security and commercialization), providing farmers with a stronger material base in their fight for equality. (Yurjevich n.d.)

Agroecological ideas and methods were regarded at the beginning as a complement to other AT technologies. However, as AT centres became increasingly involved in rural development, agroecology gained further importance and eventually became one of the legacies of the movement in the region.

One of the challenges of AT practitioners in South America was to translate global ideas about alternative development into a complex reality involving diverse political scenarios. In doing so, they inevitably drew from local ideas and debates around the region, such as popular education, participatory action research, emerging agroecological ideas and the relevance of indigenous knowledge. Focus on concrete practices allowed AT practitioners to work (with different successes) in different spaces of experimentation and also to combine different technologies (including solar technologies, agroecological techniques, composting, housing technologies). More focused in concrete action than in ideology, the process of framing was therefore flexible and reflected in part the learning process in the field. It nevertheless resulted in a brew of idiosyncratic approaches that developed their own re-conceptualisation of AT.

²⁶ For the case of Chile see (Gomez and Echenique 1988), for a study on the consequences of repression on INTA and the suppression of extension activities for the small agriculture (See Gárgano 2011).

4. Spaces for AT in South America

AT practitioners in South America were able to create centres and regional networks with financial support from international institutions. They did so by focusing mainly on rural areas and to a lesser extent on urban settings. Regional spaces for AT included international and regional networks of AT centres, universities and links with R&D institutions and the rural development arena. Work in these spaces was key to experimentation with technologies and approaches. Furthermore, through their networks, AT centres in the region were able to share learnings and designs, creating a movement of ideas and people who advocated for AT.

4.1. Regional and international networks

At the beginning of the 1980s, appropriate technology was still at its peak in the international arena and a number of international aid agencies were promoting AT around the world. In South America these institutions were key supporters, funding events, debates and some field activities, including those funded by international NGOs and bilateral aid organisations.²⁷ These networks were also built through various NGOs' directories and newsletters (for example, the magazine *Appropriate Technology* of ITDG, the German network GATE (German Appropriate Technology Exchange)²⁸ and VITA (Volunteers in Technical Assistance, USA.) among others.

International networks of practitioners were also important in spreading AT ideas and technical knowledge in the region, especially in the initial stages. Additionally, some international agencies were also concerned about the political situation in various countries in the region, making funding available for grassroots activities and poverty relief (among other things like human rights).

Contacts and learning from international networks were also particularly important to set up leading centres in the region, as was the case of AT centres in Chile. These centres would later become regional hubs that pioneered the process of re-framing AT ideas and disseminating them around the region. AT institutions like CETAL and Tekhne in Chile were originally built by former political refugees that had found asylum in Europe and subsequently returned to their home countries (Leppe and Velasco 1985).²⁹ In the case of CETAL, their first encounter with AT ideas was at the University of Louvain in Belgium. As these former political activists returned to Chile, they drew from AT ideas to create their own centres with support of international funds. Lacking any state support, Chilean AT centres relied on international cooperation from Germany, the Netherlands and France, through institutions like Diakonia and GATE to conduct their activities. Paradoxically, the retreat of the state and social services, which was especially acute in poor rural areas, created a sort of niche where AT institutions in Chile were able to work almost untroubled.³⁰

As AT centres grew in Chile, they tried to expand their activities to other spaces and other countries, through training courses and regional networks. One of these networks was created by CETAL and was based in a summer school organised from 1983 to 1988 and directed by Pedro Serrano. Every year around 30 students from Argentina, Uruguay and Bolivia went to Valparaiso to receive training in AT technologies, organic farming and to debate ideas and framings underpinning their work. The school

²⁷ For example the International Development Bank, Oxfam, Catholic Agency For Overseas Development (CAFOD), United States Agency for International Development (USAID), and others.

²⁸ In 1986, Manuel Baquedano from CETAL became a member of the international committee of SATIS.

²⁹ The story is different in the case of CET whose background was rural economy and whose founder was trained in England in biodynamic agriculture. CET practitioners started their activities under the wing of progressive authorities of the Catholic Church in Chile (Yurjevich 2014).

³⁰ See Footnote 11 (Hirschman 1986).

was an important hub of diffusion of AT ideas in South America (Serrano 2014). Former students of the school went later to create their own centres in their countries, as was the case for Centro de Estudios Sobre Tecnologías Apropriadas de la Argentina (CETAAR) in Argentina and El Centro Uruguayo de Tecnologías Apropriadas (CEUTA) in Uruguay.

Another important centre was CET, which specialised in organic farming and agroecological techniques. From the early 1980s, CET started to offer training in organic farming in Chile and then in other countries in Latin America. Later, at the beginning of the 1990s, a Latin American agroecology network, the Consorcio Latinoamericano en Agroecología y Desarrollo (CLADE) (Latin America Consortium of Agroecology and Development) was formed.³¹

In Colombia, AT projects at the AT centre and eco-community Centro Experimental las Gaviotas, (founded in 1966), and involving the University of Los Andes, were supported by Colombian-Dutch collaboration, ITDG, the United Nations Development Programme (UNDP) and UNESCO in particular (CIFI 1985; Loboguerrero 2008) to develop a wide range of technologies from solar powered water heaters to wind-driven rural water pumps. Vital for Gaviotas' growth in the 1980s was the link between Gaviotas founder, Paolo Lugari, and Colombian President, Belisario Betancur, who took a personal interest in the project. Jorge Zapp, a professor at the Department of Engineering at the University, was also instrumental in the relationship with Gaviotas. He was later also key in the development of 'popular hydroponics', low-cost hydroponic urban agriculture, particularly aimed as a livelihood strategy for low-income women in marginalised neighbourhoods of Bogotá. This approach was later replicated in other parts of Colombia and, through his involvement in projects of UNDP, across Latin American and in other world regions (Bradley 2011; Zapp 1991).

Formal, organised networks overlapped with much more informal networks based on the work and travel of few Latin American intellectuals that supported AT and carried their ideas across countries. Some example itinerant intellectuals were Amílcar Herrera,³² Miguel Altieri, Ignacy Sachs and Bonsiepe Gui.^{33,34} Ideas and concepts from these intellectuals were widely read within AT circles and helped forge and connect a common vision of AT in the region, and which in turn helped diffuse AT ideas to a wider public.

As the 1990s began, funding from international cooperation began to wane,³⁵ coinciding with the reconstruction of democracy in the region, and the rise of neo-liberal policies internationally. At this point, AT centres looked to the state and universities for funding but with mixed success. As funds grew scarce, institutions turned their attention to economic survival. As a result, the resources and energy for regional networks diminished. From that point, AT experiences and programmes, particularly in

³¹ CLADE was created in 1989 and connects most of the scholars and practitioners studying agroecology in South America. It also edits the journal *Agroecología y Desarrollo*.

³² An early STS scholar who wrote about AT and the 'social demands of technology' and was widely read during the 1970s and 1980s. In 1979 Herrera went to Brazil where he helped to create the Department of Science and Technology Policy at the University of Campinas. There Herrera worked with a young Renato Dagnino, one of the first STS scholars to do a master's thesis on AT (Dagnino 1995).

³³ Another intriguing character, Bonsiepe Gui, is a designer who worked early in the 1970s in INTEC where there was an early approach to TA in Chile and then in Argentina and was an advocator of the PTTA-CNPq programme in Brazil in the early 1980s.

³⁴ Other intellectuals that were widely quoted as inspiration were Max Neef, author of *Human Scale Development*, and Luis Razzeto, an early theorist of the solidarity economy.

³⁵ Already, in 1995 during a meeting of SATIS, Manuel Baquedano pointed out that, 'NGOs from the South need to consider more commercial approaches if they wish to remain independent; the times when NGOs could rely on a permanent source of foreign funding are over' (Heierli 1985).

Chile, Argentina and Brazil, became increasingly isolated from one another and the space for collaboration diminished.

Internationally, the term appropriate technology as a buzzword and focus of development declined over the same period, and also fell out of use in many South American nations. Nevertheless, a few key organisations retain the terminology and ideas, such as Soluciones Prácticas³⁶ in Perú or the Institute for Transfer of Appropriate Technology for Marginal Sectors (ITACAB), CETAAR in Argentina and CEUTA in Uruguay, and they remain active today.³⁷ Moreover, the networks and personal contacts created by AT practitioners during the 1980s were later continued by the same individuals and connected with broader campaigns and movements in agroecology and environmentalism like CLADE,³⁸ Maela³⁹ and Red de Acción en Plaguicidas y sus Alternativas de América Latina (RAP-AL) (Pesticide Action Network in Latin America)⁴⁰ (Souza 2014).

4.2 Scientific knowledge and the academy

A setting very different from the AT centres and their networks was that of academic activity. Scientists usually thought of AT as 'second class development', based in low-tech knowledge, and thus far from the more exciting frontiers of scientific knowledge production (Willoughby 1990). As a result of such disdain, most AT centres were established in independent institutions and NGOs. Only in a very few cases in Brazil, Chile, Colombia and Argentina, did AT practitioners gain support from scientists or became included in academic spaces like universities or scientific funding institutions.

In Brazil, AT activities began in the late 1970s under the influence of the ecological economist Ignacy Sachs and promoted by a group of designers from the Fundação Centro Tecnológico Minas Gerais (CETEC/MG). Supported by the Secretary of Science and Technology from the state of Minas Gerais, CETEC/MG tried to implement a series of appropriate technologies in the city of Juramento in 1978 (Brandão 2001). By the early 1980s, this initial experiment had been adopted by the new director of Brazil's key S&T institution, the National Council for Technological and Scientific Development (CNPq) (Conselho Nacional de Desenvolvimento Científico e Tecnológico). Director Lynaldo Calvanti Albuquerque proposed the creation of an Appropriate Technologies Transfer Programme (PTTA) for rural areas under the direction of Eduardo Barroso Neto (former member of the CETEC). Working with cooperatives, farmers and communities, the ultimate goal of the PTTA was to promote 'technological autonomy' and economic self-reliance among the rural population. Funded by the CNPq, the PTTA ran a series of activities, including a bank of AT, a survey of AT in local communities and R&D activities for AT until the end of the 1980s (Brandão 2001). The PTTA was closed at the end of the decade under the new direction of the CNPq, but only to be reprised and reformulated in 1993 as the Programme for Support of Appropriate Technologies. This new programme was mainly aimed at the production of information and diffusion of AT, but the CNPq also partnered with other institutions in the development of AT in several regions like Parana and Ceará until the end of the 1990s.

On a much smaller scale, the Centre of Economic Housing (CEVE in Spanish), an institution created by architects in Argentina interested in affordable housing technologies was incorporated as an R&D centre

³⁶ ITDG, originating in the UK, opened its first international office in 1985 in Lima, Peru. From a staff of three in 1985 and a budget of US\$50,000, by 2005 it had grown to an office of over 100 employees, with projects in 13 departments of the country and in various other Andean countries, and with an average annual budget of US\$3 million (Soluciones Prácticas 2005).

³⁷ Also in Peru, ITACAB was created in 1986 to foster exchange of experiences between member countries of the intergovernmental organisation, the Convenio Andrés Bello, primarily in Latin America, and remains in existence today.

³⁸ See Footnote 25.

³⁹ Maela is the Agroecological movement in Latin America and the Caribbean (in Spanish: Movimiento Agroecológico de América Latina y el Caribe) that includes scholars, peasants, indigenous movements and NGOs. Maela was created in 1992.

⁴⁰ RAP-AL was created in 1983.

for the National Council for Science and Technology (CONICET) in 1973 during the center-left spring of Campora's government. Even though CEVE's members only became fully aware of the AT debates in the early 1980s, their technologies and social approach was very similar to AT.

In Chile, links with scientific institutions were sporadic and ephemeral during the 1980s. For example, the Centre of Technological Education started collaboration with academic scholars in agroecology in the early 1980s. This collaboration led to the creation of the Organization of Research in Alternative Agriculture (CIAL in Spanish) which led to investigation in organic agriculture and produced several academic theses. Only during the 1990s, as the CET started to lose international funding, did the organisation turn increasingly to academia in order to create a series of teaching courses that helped to find new spaces for training and funding (Yurjevich, personal interview, 2014).

In Colombia, attention to scientists' contributions to social needs was evident among some university departments, even where social consciousness met greater resistance, such as at the more conservative University of Los Andes in Bogotá. Different research groups in the Faculty of Engineering at the University of Los Andes showed interest in AT and 'intermediate' or appropriate technologies, as evidenced by the creation of a Group on Rural Development, projects involving the Group on Technological Development, as well as the development of a seminar on S&T policy. Project-based courses encouraged students to develop final projects on appropriate technology in collaboration with NGOs and government bodies, and particularly linked to the AT Centre and eco-community mentioned above, Centro Experimental Gaviotas. Several scholars took on long-term roles and projects with Gaviotas, and many students spent time at Gaviotas, or conducted research for these there.^{41,42}

In this way, formal scientific institutions provided limited support for AT activities in South America. There was significant support in some instances, as in the case of Gaviotas in Colombia, or in Brazil. However, this support was not widespread and was limited to particular institutions where practitioners and sympathisers pushed academic institutions into providing some kind of technical support and funding.

Only in the case of agroecology did interest from academia increase over time. However, for other technologies that relied on mature technologies, the interest of scholars never surpassed small collaborations. Even in those cases where there was a more or less steady institutional support, such as the CNPq programme in 1980s or in the case of CEVE in Argentina, AT was still seen by scientific elites as marginal in relation to scientific knowledge (see Brandão 2001).

4.3 Rural development

The preferred place of intervention for AT in South America was the space of rural or semi-rural development initiatives. Indeed, it became a niche for AT due to the general lack of interest from governmental and S&T institutions. The rural population was among the poorest within countries in South America. Furthermore, restructuring in Latin America meant governments pushed market-led policies that weakened existing aid programmes for the poor (see for instance Gárgano 2011). Finally, the rural population generally lacked access to basic services like energy, drinking water and health services, and which could be ameliorated with some appropriate technologies.

⁴¹ A report on AT projects at the Faculty of Engineering at the University of Los Andes describes 89 thesis projects conducted between 1972 and 1982 (CIFI 1983).

⁴² 'With the new way of thinking from Europe and the US, and with the resources to research and develop appropriate technology, some professors from the Faculty of Engineering of the University of Los Andes became interested in the topic. Professors Jorge Zapp and Carlos Francisco Rodríguez encountered the utopic ideas of Paolo Lugari and his environmental research centre 'Las Gaviotas', created in 1966 in Vichada [Colombia], whose objective was to promote the development of local resources, and massive, wide-scale use of renewable energies. [...] Others also joined, including biologists, chemists, anthropologists and engineers from other universities such as the National University' (Loboguerrero 2008).

This does not mean that AT centres did not attempt or carry out projects in urban areas. For instance, Tekhne in Chile had a local urban programme aimed at improving housing and food conditions, specially stressing strategies and technologies that avoided wasting resources and increased savings in the family economy (Tekhne 1990). CEVE in Argentina also had several interventions in the urban and semi-urban space in social housing. ENDA-Colombia and Gaviotas also had urban projects in Colombia, the latter including the largest installation of solar hot water heaters in Latin America. However, it was clear that in the urban space AT technologies had to compete with wider access to commercial technologies.

On the other hand, the general lack of policy attention to rural areas meant AT practitioners could address rural problems without clashing with government. For example in Chile, as Serrano explains:

In some way, the NGOs that worked with AT were solving a problem for the State. Notwithstanding the fact that they (the militaries) could have disapproved if people got too organized, they did not make any waves. Because, these NGOs were working in a space where the military was absent. They did not work with the farmers, fishermen or indigenous communities, and these NGOs started to work with these populations.

(Serrano 2014)

In the case of the CNPq in Brazil, it was probably easier to justify funding of applied science and R&D in mature technologies, as well as to forge alliances with state institutions and technical organisations such as Embrater, Embrapa or the Ministry of Agriculture (Brandão 2001). Therefore, given antipathy from scientific elites, resources for grassroots funding were presented to CNPq as a Programme of Transfer of Appropriate Technologies (PTTA) for the rural sector, rather than a scientific or technology development agenda.

In Colombia, the Engineering Department of the University of Los Andes described its focus on rural areas, partly justified by identifying specific needs for technologies for processing crops, in housing, health and nutrition (CIFI 1985).⁴³

Nonetheless, the rural development arena, as a relatively neglected area under political repression and technological modernisation, provided open ground for AT experimentation for several technologies including solar heating, water recollection, agroecological techniques, housing and sanitation.

⁴³ However, the demise of AT in Colombia, at least in relation to renewable energies in rural areas, was also attributed to national policy toward massive electrification in the 1980s by President Betancur (1982-86), which undermined regional efforts.

5. Illustrative examples

Appropriate technology centres in South America experimented with different technologies that were intended to be simple, easy build, low cost and easily operated. These technologies were chosen or designed attending to the local needs and also regarding its potential to generate appropriation and solidarity. Experimentation with technologies varied according to regional needs, but also to local capabilities and interest. Among a broader range of technologies, there is a certain pattern related to perceived environmental problems and needs of the poorest population. These include, energy (in particular solar energy), sanitation and agroecology. Almost every AT centre developed technology in those areas in the region.

5.1. From solar to social housing technologies

Solar technologies: The design and implementation of solar technologies is related to the cost of fuel and the lack of access to energy for housing and production in rural areas. The use of some solar technologies provided a source of energy that could be complemented with other sources like biomass. Some of the solar technologies developed in the region include solar heaters, solar dryers for fruit or solar cookers. These were generally based on simple designs that tried to make use of available material and avoid costly inputs. For instance, a solar heater designed by CETAL is described as a provisional, low cost artefact that could last up to two years and could be made using discarded water bottles, wood and glass (Serrano 1985). In Colombia, the Gaviotas Centre was able to install solar water heaters in big urban developments and hospitals. Variation of these designs are widespread in South America and they have been adapted to other uses like water purification (see for instance Fressoli *et al.* 2013). Another heating technology that was fairly common in the region was the so-called witch cooker (in Spanish: *Cocina bruja*). The witch cooker is basically an insulated capsule that insulates a cooking vessel already heated to a specific temperature, but with the heat source stopped, and the witch stove blanketing the pot in order to conserve its heat. Depending on its characteristics and the food prepared, the witch cooker maintains the heat and continues the cooking process for up to 90 minutes. It was especially used in preparing stews, a popular and economic staple in the region.

Sanitation: Sanitation was a particular problem due to the lack of infrastructure in shantytowns and rural regions. AT centres like CETAL developed a composting toilet design for this problem. It was based on a 200 litre recycled tank that allowed for anaerobic fermentation. The tank provided a controlled environment that after three months could be harvested for safe, dry compost ready to use in the organic garden of the house. With variations, the design of the composting toilet was also promoted in Argentina and Uruguay and later in Brazil.

Other technologies developed in South America included social housing techniques and low cost building material, water tubes using bamboo, water pumps, recycling techniques and biodigestors. A survey of AT produced at the end of the 1990s shows more than 40 different appropriate technologies (including those mentioned above) in use in Brazil, Colombia, Venezuela and Bolivia (Tratado de Cooperación Amazonica n.d.).

Beyond the diversity of technologies, it is important to note the repetition of the same designs in several countries in the region. One of the reasons for this repetition is that most of these technologies were taught and shared in regional workshops like the CETAL's AT summer school, or through manuals and courses offered through the regional network of the Convenio Andrés Bello (for example, Sánchez Narvaez 1996). They sometimes formed part of the same strategy of intervention and, for instance, the witch cooker was combined with other technologies like the composting toilet and organic farming into a rural AT package. By offering a set of technologies instead of a single solution, AT centres also aimed

at addressing the complexity of social needs, especially in rural settings and emergency scenarios⁴⁴ (see for instance Serrano 1985). In any case, definitions of what technology was to be used for and how to use it were aimed to be developed in a dialogue with social actors on the ground, be these impoverished communities, isolated rural populations, indigenous communities or other NGOs working in the field. To do so, AT centres built a set of approaches that attempted to foster community participation and self-government. This approaches varied regarding whether they were dealing with vernacular technologies (i.e. indigenous knowledge), AT designs from other parts of the world (for instance AT technologies designed in other countries), or new technologies (Serrano 1985; Tekhne, 1990). In some cases, they included at least one member of the community in the process of the design or adaptation of the technology (Leppe and Velasco 1985). Once the technology was designed and built it was still subjected to a process of cultural and technological evaluation by the community that was to use it. Eventually the technology could be modified or discarded by the community. The aim of the process was to ensure the engagement of the community in the process and to encourage its self-organisation (and solidarity) in order to produce the appropriation of the technologies. As Serrano argues, 'Any process of transference of technology that did not take into account in depth the human factor of social actors is bound to fail, especially if they involve issues of development and the lifestyle of the community' (Serrano 1985: 66).

However, building participation was a laborious process that took a lot of time. In cases where there was the need to design a new technology, this process could take years. This time scale presented a lot of challenges to AT centres in terms of resources, allocated time for projects and funding. External funders did not always understand this process and pressured for outcomes to be produced quickly, disregarding the time and subtleties involved in working with communities and fostering 'horizontal communication' among actors. Furthermore, as AT centres depended on external funding, the continuity of projects was precarious.

Beyond the process of participation, there was also the challenge of how to design technologies that could be improved and upgraded over time, and eventually be able to compete with market-based solutions. With a focus on low-cost and simple solutions, this was not an easy task. And perhaps that is why some of the technologies survived the passage of time and others did not. As Nicolas Espinosa put it:

AT ideas were thought as solutions and the technologies for the problems of the 1980s. But, as access to certain goods was massive, technology started to lack its appropriateness and innovative characteristics. It did not make any sense to build a solar collector when you could buy it ready-made.
(Espinosa 2014)

Despite this fact, original designs of AT survived somehow and some of these technologies are still in use today. In some cases, old AT technologies continue to be redesigned, for instance the composting toilet recently redesigned by the Social Technology network. Although technologies were widespread, what seems to have attracted most attention have been agroecological methods.

5.2 Agroecological methods

As we have seen, the rural and semi-rural space constituted a favoured location of intervention for AT centres in South America. Agroecology became a centrepiece for many AT strategies in the region and most institutions developed training courses or applications. The hands on and relatively accessible experience of farming allowed centres to introduce agroecology along with other technological

⁴⁴ In Chile, AT technologies like basic emergency housing, sanitation techniques and solar energy were adapted to natural emergencies following the earthquake of 1985.

developments. Conversely, for agroecologically centred institutions like CET, AT became regarded as complementary to their main activities and useful in areas such as crop processing and storage.

Methods and technologies for agroecology drew from previous experience (and in some cases to the social memory) of the population. Training was focused on the construction of small farms and involved techniques like compost, rotation of crops and introduction of local varieties of vegetables. AT centres usually provided a basic training, which could later be upgraded to widen the scope of technologies and concerns about agroecology, including in food production, animal farming, tree gardening, basic water pump technology, fruit drying.

These developments were *Aprender a hacer* (learning to do) from CET, *Cuadernos Populares* (Popular Textbooks) at CETAL or the *Minka* magazine edited by Grupo Talpuy in Peru.

More than any other technology in the region, the development of agroecological methods placed the AT vision in between its scientific-rational background and the need to connect with local and indigenous knowledge. AT groups tried to bridge this space in two steps. First, there was a systematic effort to retrieve indigenous knowledge in agroecology including knowledge about ancient crops, alternative seeds and medicinal plants. This effort was primarily aimed at keeping and retrieving useful indigenous knowledge and stop it being systematically lost. AT centres tested plants in search of their chemical properties, as in the case of herbal plants carried on by CETAL, or selected some cases for academic research, as in the case of CET. At the same time, retrieving indigenous knowledge was seen as a tool to empower local communities by highlighting the cultural value of their practical knowledge. Agroecological techniques combined with indigenous knowledge and scientific attempts at validation eventually led to the creation of its own networks of learning and advocacy that overlapped and complemented AT.

Agroecology thus became a movement of its own, surpassing interest in AT technologies. Agroecology has been relatively successful in keeping its participatory approach and gaining institutional recognition.⁴⁵ And yet it still faces some of the same dilemmas faced by AT in terms of market competition and pressures to scale up.

⁴⁵ For example, in Colombia, a new PhD programme in agroecology was recently established in 2000, involving several public universities.

6. Discussion: Pathway Construction

AT ideas in South America were pursued amidst economic crisis, the 'lost decade' of development in the region, and the need to devise new forms of political mobilisation and engagement. In this context, appropriate technology advocates were moved by the urgency of local needs but worked towards a long-term vision of creating alternative pathways of development based on political autonomy and sustainability.

6.1. *Global decline and transformation of AT ideas*

During the 1980s the favourable context for the AT movement began to change internationally. As neoliberal policies pioneered in Chile began to unravel in the USA, UK and other countries, ideas of structural adjustment hit development agencies (Rist 2011). In the USA, the Reagan Administration dismantled the institutions and icons of AT including the solar panels that the previous president Carter had installed on the roof of the White House. According to Pursell (1993) this symbolic action illustrated the difficulties that AT had in challenging the idea of development and incumbent powers in sectors like energy. By the mid 1980s funding agencies and international donors also started to abandon the idea of appropriate technologies and official development attention worldwide 'lost momentum' (Pursell 1993: 629). The lack of interest in AT internationally inevitably affected AT efforts in South America, where international aid was an important support to it. However, this did not immediately stop the AT movement as centres in the region remained, and some even grew during this period.

AT practitioners in the region took advantage of a new context of political opportunity, freed from dictatorship and towards democracy in Chile, Brazil, Argentina and Uruguay. In this context, AT centres took advantage of shifts in international cooperation that sought to support the democratisation process in the region. In some cases, like Tekhne in Chile, CETAAR in Argentina, CEUTA in Uruguay or ITACAAB and Soluciones Prácticas in Peru, international funding of projects lasted until the 1990s and 2000s, some remaining today. In this context, AT centres continued working in the space of rural development.

The decline of AT in Europe during the mid 1980s seems to have pushed, not so much the demise of AT in South America, as the beginning of the end of its social movement. The 1990s was perhaps the moment where existing connections and projects started to dwindle. To make matters worse, during the 1990s South American countries increasingly adopted neoliberalism and applied it towards S&T, emphasising the establishment of productive links between research and industry through technology transfer and other means oriented towards international export, rather than local socio-economic problems (Thomas *et al.* 2000). This approach was opposite to the goals of participation and inclusion proposed by AT practitioners. Those centres that survived did so by reducing the space and scope of their activities, offering courses or consultancy and trying to insert their activities into universities. However, in some cases this path affected the earlier values and practices of AT in South America.

6.2. *From AT to Agroecology*

AT centres in Latin America started with ideas and technologies they often brought from Europe and the USA. Very soon they found out that they needed to adapt their method of design and implementation and to bring aboard participatory techniques. AT centres in South America started in most cases to develop a broad range of technologies, including solar cooking, social housing techniques, sanitation technologies and agroecological methods. However, as some of these technologies, such as solar heaters and solar cookers, became widely available through market means during the 1990s AT attracted less and less attention. The fact that anyone could access the technologies promoted by AT centres could also be interpreted as a sign of success. However, it is perhaps better to think of it as a partial success since these ready-made technologies lacked any participatory process.

Agroecology stood out among the other technologies since it was especially suited for the rural context and provided AT centres with a tractable and easily understood set of techniques. Agroecology was arguably different to the rest of the AT technologies available, since it was already connected with local knowledge and traditional practices and was easily linked with the needs and interest of peasants and small farmers. It also provided an opportunity to enrich this knowledge with scientific ideas and methods. Moreover, it was a set of technologies that were clearly opposed to the practices and methods of agribusiness (Wezel *et al.* 2009). These elements created a niche where agroecological techniques were developed both in the field and in academia (although it generally remained marginal in universities and R&D institutions).

As the AT movement dwindled in the region, the newly formed agroecological networks like CLADE, MAELA and RAP-AL picked up the baton of grassroots innovation. These networks shared connections and were sometimes formed by the same practitioners from AT centres. In this way, agroecology helped to carry on some of the ideas, technologies and frames of AT.

The movement toward agroecology thus shows the continuity and adaptation of some of the AT's practitioners as they navigated the difficult changes in the political, cultural and cognitive scenarios of the 80s and 90s.

6.3. Technology for autonomous citizenship

AT activism in Latin America was somehow a pragmatic answer to the shortcomings and risks that traditional political activism posed at the end of 1970s. At the same time, a new context of economic crisis and impoverished populations required immediate solutions to basic needs. After the political repression of dictatorship, economists, engineers, architects, agronomists and other former militants decided to revise ideas about mobilisation and political formation. In countries like Chile, dominated by an authoritarian regime, the classic demands for political autonomy and social integration through an increased share of state resources and popular control over political economy was meaningless and dangerous (Garretón 2002). In cases like Argentina and Uruguay, AT centres become part of a new wave of mobilisation around NGOs and concrete activities of social development that marked the return of democracy.

AT ideas provided some tools to confront paternalistic and large scale social programmes and envisioned development on a human scale. Suited for small scale and do-it-yourself, AT technologies became a fertile ground for participatory experiments and designs which attempted to include beneficiaries in several stages of technological development. Certainly, not every effort fell into these development patterns or were able to develop inclusive approaches. As the experience of Talpuy Group, CETAL and others shows,⁴⁶ in some cases AT groups also struggled at the beginning with their strong technical rationality and lack of understanding to the cultural context, and eventually they challenged these limitations and learned from experience to focus on participation instead of technology prowess.

The importance attributed to participation and empowerment is central to understanding the effort of some AT institutions in South America. As AT practitioners realised the difficulties and structural modification that the new political scenario of economic crisis posed, they turned to building immediate solutions to poverty and exclusion. They did this by developing artefacts, techniques and material practices in order to replace former ways of political action. Translating old political ideas about mobilisation into the technical clothes of AT was also part of a new strategy that sought to promote autonomy from the State. In this way, hidden beneath the social work and technological solutions laid an attempt to recreate forms of political conscience and participatory activism and the use of technology as a means to empower citizens. Ideas about participatory research and technological

⁴⁶ See also (Fressoli *et al.* 2013) for a recent example.

autonomy were later taken on by other grassroots movements or networks, most notably the Social Technology Network in Brazil at the beginning of the twentyfirst century.⁴⁷

The extent and complexity of the concern for participation was such that it permeated given ideas of appropriate technology and prompted the creation of new definitions like 'socially appropriate technologies' and 'socially appropriated technologies'.

However, as the AT movement was disbanded and practitioners isolated, knowledge and experience about participation became diluted and forgotten. Without a shared space to learn and advance participation, empowerment and socially appropriate technologies, new AT enthusiasts struggled with the very same problems of technical rationality and paternalism that affected the first wave of activism in the early 1980s.⁴⁸ Lacking a social movement that fostered experimentation and new approaches, the idea of AT became just a phantom of its former past.

Furthermore, as AT and participatory development ideas became inserted in some academic or research institutions and NGOs, their aim of empowerment was sometimes captured to demonstrate adoption of technologies that were already developed and on-the-shelf. For example, participatory research and innovation methods were sometimes leveraged as a way to convince farmers to use these existing technologies, thereby diluting the notion of co-research (Ashby 2009).

In this context, it is not surprising that the memory of AT has become that of a paternalistic approach that dismissed local knowledge and participation. This image of AT was fostered by early studies of AT which criticised the underlying inference of technological determinism that permeates AT's ideas of development and well-meant but problematic attempts to experiment with poor country development (Rybczynski 1980). As new revisions retook critics more recently, they only saw a distorted image of what the AT movement was in the region and what were their goals in terms of empowerment and development (Thomas 2012). What critiques of AT in this case seem to be missing is not the lack of technological determinism but the constant tensions between technical rationality and participatory approaches. AT practitioners usually reconciled these tensions and made notable efforts to experiment with approaches that enabled social participation, and some instances of co-design. In this sense, following Willoughby (1990: 250), we think that attempts to posit AT as technological determinism might be misleading since they 'artificially separate technological factors from political factors' and the broader framings under which AT centres were operating. By doing so, they fail to understand the importance of AT as a social movement that sought to experiment with empowerment, technological *and* political autonomy.

Moreover, as AT work was combined with political formation and ideological debates, it was transformed into a politics of technological resistance to the structural changes that had been imposed by neo-conservative policies in the region. At this point, technology became a tool for AT centres in what was in reality a fight against exclusion and inequalities. At the same time, AT advocates were building ideas, knowledge and technologies that ultimately pointed to alternative pathways of development. The capacity of AT centres to spearhead alternative visions and practices of development in the region is perhaps the less understood aspect of the movement.

⁴⁷ Participatory action research developed in Latin America by AT centres and other social movements was later to influence environmental practices of citizen science in Canada and the USA (See Moore 2006).

⁴⁸ For a recent example of the struggle of AT enthusiasts with technical rationality see (Fressoli *et al.* 2013).

7. Conclusions

With some exceptions, the AT movement arrived at South America at the beginning of the 1980s in the midst of turbulent times characterised by political repression, economic adjustment and the foreign debt crisis. Internationally, AT was already passing its peak of interest and the decline of the movement was close due to the wave of neoliberalism (Kaplinksy 1990). And yet, in South America, AT practitioners found fertile ground to develop technologies and new approaches for the particular realities of the region. Even swimming against the current, the AT movement in South America was a vibrant and bold social experiment that thrived in some rural settings and was replicated in different countries. Two elements of this history are particularly interesting contributions to ideas about the construction of alternative pathways of development and might bear lessons for other grassroots innovation movements.

First, in many contexts, AT practitioners experimented with participatory methods and created their own approach to technological design. They did so by drawing from regional intellectual influences like Paulo Freire and Orlando Fals Borda and from a history of social and political mobilisation. They also took on the difficult task of combining local and indigenous knowledge with scientific principles. Thus, the AT movement in South America devised a participatory approach where technology became an instrument to foster social empowerment, create solidarity bonds and strengthen local identities. Interestingly, the participatory approach was almost forgotten after the movement started to lose momentum. The image that remained of the movement regarding technology design was that which was left behind in handbooks, that gave the impression of, and criticisms that focused attention on, AT as technological fix.

Undoubtedly, some of this fixation with technology was present, and with the social movement absent, this has probably worsened today. And yet when the Social Technology Network retook some of the ideas, frames and technologies of AT in Brazil, an inclination toward technology fixes was not a real concern.

A very different critique highlights the difficulties to scale-up experiences and sustain activities over time. This is point raised, for example, during discussions about the Social Technology Network in Brazil (see Fressoli and Dias 2014).

The dilemma of how to produce structural changes while depending on project-based funding was a major problem for AT centres. However, it will be misleading to think of AT outcomes as a failure to scale up in light of the new scenario of public policies for social inclusion of the early 2000s, something that was notoriously absent, or challenged, in the 80s. In fact, we should note that strategies of mobilisation of the AT movement in South America relied on a very different set of resources namely, NGOs, regional networks and international aid funding. This means that the framing of mobilisation was precisely based in gaining autonomy from the State. Therefore, apart from attempts in Brazil, the idea of developing public policies to allow the continuity of AT initiatives was largely out of the question.

Instead of trying to address the problematic issue of impacts and outcomes, it is indeed more interesting to note how at the time the AT movement in South America showed a remarkable capacity to learn and modify its frame and pathways. It was precisely this capacity that allowed AT practitioners to move from earlier AT approaches to agroecology and rural development. In this way they enlarged the networks of alternative development that began with some of the AT centres and that continues until today.

Overall, the analysis of framing, spaces and pathways of AT in South America shows that grassroots innovation activities were not a fixed endeavour that relied somehow on established theories or pure

technical rationality. Instead, we have tried to show how AT practitioners, due to dynamic political economic contexts, shifted their political and mobilisation strategies from social conscience and mass mobilisation of the past, to develop new, more pragmatic strategies for advancing ideals with an acute awareness of opportunities and limitations under the political economy of the time.

As a result, the AT movement in the region (and worldwide) was able to give impetus to ideas about technology whose subsequently quiet, often hidden influence over the years is visible in sustainable innovations today. Moreover, processes for public participation and the inclusion of local knowledge, made so apparent by appropriate technology principles, have become common practice in development projects (Chambers 1997; Pieterse 1998), subsequently subjected to its own associated critiques (Cooke and Kothari, 2001; Hickey and Mohan, 2004).

So whilst appropriate technology as a category slipped away from the development agenda, the movement practitioners, fieldworkers, and development professionals dispersed into multiple new development debates, agendas and currents of funding. Development practitioners and fieldworker attention have had to re-orient to this new context. And yet some of them remained engaged in different activities that planted the seed for current grassroots innovation efforts. In this way, well beyond technologies, both participatory methods and the new networks and ideas that sprang from the AT movement are perhaps its most important legacy in South America.

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