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Sustainability transitions in developing countries: Major insights and their implications for research and policy

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ABSTRACT

Sustainability transitions literature is a rapidly growing and influential field of research. It argues for a radical change of systems providing human needs. Being triggered by the negative implications of the Western post-war model of development, major transition frameworks such as multilevel perspective, strategic niche management or transition management have been widely used to clarify and motivate socio-technical transformations in mainly more economically developed world. Because of their sustainability appeal, however, transition perspectives began to be applied in developing countries. This paper takes stock of and systematises the theoretical insights from this application. Using systematic review method of 115 publications released in the last decade, the paper discusses novel methodological and conceptual lessons around: experimentation and upscaling; stability, change and power; regime uniformity; contextual forces; path-dependence; transnational linkages; normative orientation and other aspects. Although the identified insights confirm the middle range character of the transition theory, they force some reflexivity and raise new research questions for both contexts. The paper also identifies a few policy implication for international organisations, donors, governments and civil society organisations.

1. Introduction

Sustainability transitions literature is a rapidly growing and influential field of research (Markard et al., 2012; Chappin and Ligtvoet, 2014). It builds on the argument that the interconnected, complex and global character of current challenges such as climate change or growing social inequalities, requires a radical change in the basic systems providing societal needs for energy, water or shelter (Schot and Kanger, 2016). The term we use to describe such a change is transition, whereas the systems that need to undergo the transformation are conceptualised as socio-technical (see Fig. 1). Socio-technical implies that every aspect of life, from technology, institutions, economy to the socio-cultural sphere, must transform for a system change to be effective (Elzen et al., 2004; Wieczorek and Berkhout, 2009; Grin et al., 2010). Thanks to its sustainability potential, the notion of socio-technical transition has attracted attention in policy circles. Policymakers are interested in transitions because incremental, technical changes based on end-of-pipe solutions, cleaner products or eco-efficiency, are not believed to lead to sustainability (Wieczorek and Elzen, 2005).

Various models developed in this field aim to explain how transitions unfold and how to govern them. The most fundamental model, which has also formed the basis for other approaches, is the Multilevel Perspective on system innovation (MLP) (Geels, 2002, 2005). MLP distinguishes three levels, as shown in Fig. 1. The central level comprises of socio-technical regimes: sets of rules and routines that define the dominant 'way of doing things'. Regimes account for path-dependence, stability and are often locked-in, which hinders radical change. Regimes are stabilised by the socio-technical landscape, a 'broad exogenous environment that, as such, is beyond the direct influence of actors' (Grin et al., 2010, p. 23). Landscape encompasses such processes as urbanisation, demographic changes, wars or crises that can put pressure on regimes making them vulnerable to more radical changes. Regimes transform on condition of availability of alternatives that can fulfil the same societal function. Alternatives are developed in niches, protected spaces, that facilitate experimentation with novelties. In the context of the MLP, system transformation is driven by change agents and occurs in the outcome of mutually reinforcing contextual, landscape pressures, internal regime destabilisation processes and upscaling of innovations developed in niches. The orientation of change is assumed sustainable with strong emphasis on the environmental aspects. The strategic navigation of the process of niche formation is labelled as Strategic Niche Management (SNM) (e.g. Kemp et al., 1998; Raven, 2005; Schot and Geels, 2008). SNM argues for shielding, networking, learning and alignment of expectations as preconditions of construction, empowerment and upscaling of niches (Smith et al., 2014). Transition Management (TM) perspective (e.g. Loorbach and Rotmans,

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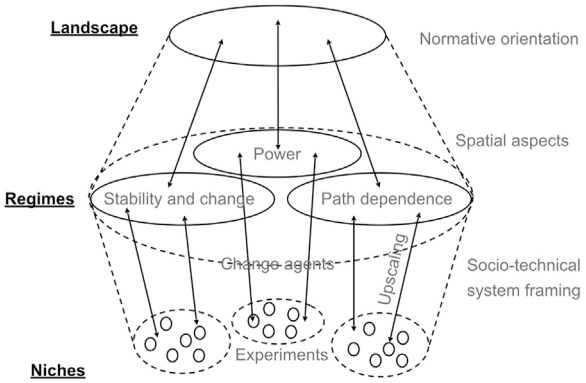

Fig. 1. A multilevel perspective on system innovation showing the key aspects. Adapted from Geels (2002).

2006, 2010; Loorbach, 2007) has been developed to shed more light on navigating this complex process. Its essence lies in influencing, coordinating and bringing together (niche) actors and their activities in such a way that together, they can accelerate the change towards sustainability.

Triggered by the negative implications of the Western post-war development model, the major transition frameworks (MLP, SNM, TM)[1] have been widely used to clarify and motivate socio-technical transformations in the more economically developed world. Thanks to their sustainability appeal, these approaches were later adopted in rapidly developing Asian economies (e.g. Berkhout et al., 2009a,b, 2010, 2011), and in the least developed countries of Africa (e.g. van Eijck and Romijn, 2008; Byrne et al., 2011; Baker, 2015). This application resulted in a number of lessons which have not been systematically analysed, preventing policy recommendations regarding ways to stimulate transitions in the developing world.

This paper takes stock of and systematises the theoretical lessons learned. In particular, I focus on novel conceptual lessons and search for methodological and disciplinary extensions of the three dominant transition frameworks. I also identify new research directions and policy implications. The overall aim is to reflect on what we can learn from the use of transition approaches in non-Western contexts. The research question I address is:

What are the major lessons from applying transition approaches to studying system innovation and the prospects in developing contexts, and what do they imply for further research and policy?

This paper is based on a systematic review of transition literature as applied in developing and emerging economies, and structured as follows: In Section 2, I explain the research methods. Section 3 is an overview of the insights based on the sample of 115 analysed documents written between 2005 and 2016 and structured along the MLP levels and concepts. In Section 4, I reflect on the policy implications of these insights and potential new research directions, concluding with Section 5.

2. Methods

In social sciences, the systematic review method has been developed as a transparent and rigorous approach to identify and synthesise research findings (Petticrew and Roberts, 2006) of sufficient quality about a specific research question or subject (Higgins and Green, 2010). The systematic review is considered particularly useful for disseminating key findings of large and complex bodies of research literature. It is guided by a set of clear principles to highlight opportunities for further research (Briner and Denyer, 2010). According to Victor (2008: 1), the following features distinguish a systematic from a traditional literature review: “as far as possible, it should be comprehensive in its coverage of the literature; pay careful attention to the quality of included evidence; take a clear, systematic approach to the synthesis of the data; and generally follow transparent and rigorous processes”.

These four factors served as guidelines for this paper. I selected a comprehensive set of contributions that adequately represents the body of work published within the field of sustainability transitions in developing countries. To ensure the quality of the evidence, I chose peer reviewed journal articles, books and PhD theses included in Scopus. To comply with rigour and transparency requirements, I followed a systematic process of identifying and analysing publications.

There have been at least four earlier efforts to map the contours of sustainability transitions literature and identify the publications that constitute this field (Geels, 2013a,b, three bibliometrics analyses by Markard et al., 2012; Chappin and Ligtvoet, 2014; Sengers et al., 2016). As these and other bibliographic analyses in transitions studies were either conducted up until 2013[2] or focused on specific themes e.g. experimentation (Sengers et al., 2016), I decided to carry out a new Scopus and Web of Science search as described in Table 1.

Since MLP provides a common theoretical foundation for SNM and TM, I chose to organise the specific lessons following the logic and concepts of the MLP rather then per framework. This includes (see Fig. 1, from bottom up): *niche* formation, experiments as seed of change, process of upscaling, change agents and factors, spatial aspects of transitions; issues related to *regime*, its stability, change, power, path dependence; *landscape* forces and a more overall system framing and a normative orientation of change.

3. Major insights

3.1. Niche formation

Niches are shielded places where radical innovations emerge, away from the pressure of existing regimes (Raven, 2005) see Fig. 1. The early transition literature on Strategic Niche Management (SNM) distinguishes three internal niche processes: the formation of networks that support and nurture novelties, the learning processes and the articulation of expectations to guide the learning processes (Grin et al., 2010).

Niche formation including the three nurturing processes is the longest studied theme in the literature on transitions in the developing world. The SNM framework is used to assess the state of the niche and inform policy. It is, in general, found a useful tool for analysing unfolding and technological cases (see Sale and Dewes, 2009; Shah et al., 2009; Rehman et al., 2012; Sun and Xi, 2012 respectively). Most of the lessons learned can be seen as a reiteration of the framework (Opazo, 2014; Byrne, 2009; Verbong et al., 2010; Derwisch et al., 2016; Kamp and Bermúdez Forn, 2016; Xue et al., 2016). SNM is also often used in a non-standard way, e.g. for value chain analysis (Rehman et al., 2010; van Eijck and Romijn, 2008; Caniëls and Romijn, 2008b; Caniëls et al., 2007) or is enriched with other theories, such as learning-based approaches (Drinkwaard et al., 2010; Romijn et al., 2010) and Social Network Analysis (Caniëls and Romijn, 2008a). These extensions give

[1] A Technological Innovation System (TIS) perspective (Bergek et al., 2008; Hekkert et al., 2007; Wieczorek and Hekkert, 2012) is often considered as one of the transitions frameworks. However, following the analytical steps explained in the methods section, and in particular using the combination of the keywords ‘TIS’ and ‘transition’ or ‘transformation’ yields hardly any documents. This confirms that TIS originates from a different body of scholarship than MLP, SNM and TM. A quick screening of ‘TIS articles' on developing contexts (ca 50 in the analysed period) further shows that TIS is rather used to clarify the diffusion of specific technologies than to reflect on broad transition processes, which is the focus of this paper. I therefore excluded this framework from the analysis.

[2] Although 2013 may seem recent, transition studies is a rapidly developing field; excluding recent publications would have a negative impact on the findings presented in this paper.

Table 1
Analytical steps.

1	First, a basic search for relevant documents was performed using (transition* OR transformat* AND sustainab*) keywords for the period 1980–2016. After refinement to relevant fields (excluding e.g. medicine or veterinary) and language, this screening yielded 9851 basic documents, serving as basis for a further search.
2	The 9851 documents were screened for MLP applications using (multilevel OR multi-level OR mlp) keywords, resulting in 808 documents.
3	Screening the 9851 documents for TM applications using (tm AND management) keywords produced 130 documents.
4	The 9851 documents were screened using (sociotechnical OR socio-technical) keywords to find general (GEN) publications on socio-technical transitions to sustainability). This yielded 634 documents.
5	The 9851 documents were screened for SNM applications using (strategic AND niche AND management OR snm OR niche) keywords. This yielded 329 documents. However, several 'usual suspects' did not show up in the search results. They did not contain the words 'transition' or 'transformation' in their title, abstract or keywords despite a relevant focus, hence:
6	A separate search was performed for SNM applications using (strategic AND niche AND management OR snm) keywords, which after further refinement by field and language, yielded 236 additional (mostly overlapping with the above) documents.
7	Steps 1–6 were verified by a similar search in Web of Science.
8	'Developing countries' were not part of the above search, hence (808 + 130 + 634 + 329 + 236) = 2137 abstracts were screened manually. A country was considered 'developing' according to the International Monetary Fund categorisation (IMF, 2015). After removing the overlap, this search produced 115 relevant documents.
9	The 115 documents were included in an Excel database and classified using the following categories: authors, title, journal, volume, year, abstract, doi/URL, author keywords, type doc, source, first author affiliation, socio-technical system studied, geo-scope, analytical focus (e.g. pathways, power), conceptual, methodological lessons identified by authors, other disciplines used.
10	The 115 publications were analysed in detail to identify lessons learned, new research avenues and policy implications. A statistical analysis was carried out to show the publication dynamics.

additional insights into the morphology of the network and its implications for successful innovation.

Regarding shielding, there seem to be two opposing views in the analysed literature on the source and form of protection. On the one hand, governments especially in China (Hu et al., 2015; Xue et al., 2016a; Xu et al., 2016) and India (Moallemi et al., 2017; Gopakumar, 2010; Roy et al., 2013), are seen to play a central role in: devising policies that could foster regime shift, allocating resources to promote low-carbon energy transitions, and mobilising financial organisations and the private sector to finance low-carbon energy systems. On the other hand, it is observed that many centralised state programmes are target-oriented and subsidy-driven, and thus provide little incentive for learning, monitoring and evaluating innovations (Rolffs et al., 2015; Rehman et al., 2010) or energy efficiency financing (Streitferdt et al., 2016). The inefficiency of state interventions is found to give rise to alternative ways of financing sustainability-oriented projects through new business models (Rehman et al., 2010) and banks' innovative funding schemes such as 'carbon finance' (Lambe et al., 2015) or 'proto-markets' (Neef et al., 2015). These are said to provide better 'niche protection' than classic subsidies. Both may result in necessary micro-trade arrangements.

3.2. Experiments and upscaling

Experiments in sustainability transition studies are considered important seeds of change (Kemp et al., 1998). They contribute to niche development (Raven, 2005; Van den Bosch, 2010) and may eventually influence regimes after successful upscaling see Fig. 1. The upscaling strategies have been elaborated with a variety of concepts such as (technological, institutional, cultural) anchorage (Elzen et al., 2012a), translation (Smith, 2007) value creation (Elzen et al., 2012b) or empowerment (Smith and Raven, 2012; Smith et al., 2014) extending the original SNM framework.

The first interesting contribution in the analysed articles is the definition of 'sustainability experiments' as inclusive, practice-based and challenge-led initiatives designed to promote system innovation through social learning, under conditions of deep uncertainty and ambiguity (Wieczorek et al., 2015a). These experiments are found to emerge in the context of the growth of new socio-technical regimes in key sectors of especially latecomer countries (Berkhout et al., 2010). Jolly et al., 2012 refers to this phenomenon as the 'shift in innovation from the West to the rest'. This shift is facilitated by transnational connectivity (Wieczorek et al., 2015a; Berkhout et al., 2011) and the emergence of innovative funding schemes (Lambe et al., 2015; Rehman et al., 2012). It also has implications for the direction of innovation, as there is more interest in innovation for and by the poor and with a lower environmental footprint (Jolly et al., 2012; Wieczorek et al., 2015a). (More) heterogenous actors initiating experiments in developing countries engage with transnational networks and infrastructures to gain access to resources and markets, thereby configuring innovative capabilities in lower-income settings, which in turn lead to the growth of new industrial sectors. The experiments therefore represent a significant new source of innovation and capability-formation and point to a broader, more socially-embedded model of innovation (Berkhout et al., 2009a,b, 2010, 2011; Angel and Rock, 2009), an issue that conventional growth and innovation theory cannot explain. This gives hope that convergence in economic structure, growth rates and welfare can be decoupled from convergence in the resource and environmental footprint of development. Consequently, new industrialisation and urbanisation pathways can emerge, embedding less pollution and fewer materials and energy-intensive processes. For innovations to have a transformative effect, however, regime and landscape forces must be aligned (Berkhout et al., 2009; Johnson and Silveira, 2014). Rock et al. (2009) warns that a synchronised global shift towards sustainability may be impossible due to unevenness in regulation, compliance, and concerns at various scales that will persist despite global warming and the accumulation of pollution. Rock et al. (2009) concludes that sustainability transition is a hard slog rather than a leapfrog.

Regarding upscaling, scholars make two observations. The first is recognising that while technology is important (Rehman et al., 2010), institutional (Patankar et al., 2010) and political aspects (Opazo, 2014; Lebel et al., 2010; Amars et al., 2016; Hess and Mai, 2014; Swilling et al., 2015) form the major barriers to transition and upscaling. Actors initiating experiments use various strategies to cope with barriers, depending on the context and support available (Hermans et al., 2016; Wigboldus et al., 2016; Jolly and Raven, 2015). State engagement and support are found particularly important in urban Asia (Bai et al., 2010; Berkhout et al., 2012). Bai et al. (2010) show that many upscaled projects have strong 'vertical' (niche-regime type) linkages with state or national governments, while international development agencies' initiatives, with no vertical linkages, are seldom diffused or lead to a change in practice. Bai et al. (2009, 2010) focus on the importance of 'horizontal linkages' (between experiments or between regimes) such as coordinating and aligning visions in different governmental sectors, and avoiding pollution by shifting the burden elsewhere. The second observation refers to the design (e.g. Vreugdenhil et al., 2012) and micro-management of experiments (Drinkwaard et al., 2010; Romijn et al., 2010). References are made to development studies' concept of 'project interventions' and how it can enrich the definition of experiment by giving more attention to the way projects are set up, and whether they actually meet peoples' needs and help to build problem-solving capacities. These capacities are considered essential to facilitate the projects' lasting self-reliance and self-sufficiency once support is withdrawn.

3.3. Change agents and factors

Change agents and factors refer to all types of stimuli that can influence the process of change in a desired direction. Often mentioned in the context of managing transitions, they can be a variety of actors or technical, societal, political, cultural, market forces (Grin et al., 2010).

Scholars analysing transitions in the developing world reflect on the circumstances that impact on how changes unfold (or not). With few exceptions (Wieczorek et al., 2015a; Jolly et al., 2012; Berkhout et al., 2011), the examined articles are embedded in the conventional development paradigm, that is to say they agree, or at least do not contest that innovations originate from the North and need to be absorbed by the South. They therefore elaborate on the conditions whereby a foreign technology transfer can spur a more radical change in a sustainable direction (e.g. Opazo, 2014). The insights do not differ greatly from those for developed countries and include a mix of: technology feasibility (Van Oosterhout et al., 2005), various forms of capabilities and competencies (Slingerland and Schut, 2014; Hess and Mai, 2014; Wolfram, 2016; Ferigotti et al., 2016; Jolly and Raven, 2016), institutions (Slingerland and Schut, 2014; Hess and Mai, 2014; Jolly and Raven, 2015), national policies (Johnson and Silveira, 2014; Bagchi and D'Costa, 2013; Moallemi et al., 2014; Xu and Su, 2016; Vazhayil and Balasubramanian, 2012), ethics (Berkhout et al., 2012), conflict (Romijn and Caniels, 2011; Baker, 2015; Mason, 2009), public–private alliances (Johnson and Silveira, 2014; Gopakumar, 2010), global interfirm networks (Hansen and Nygaard, 2014; Bagchi and D'Costa, 2013), structural and geographical conditions like fossil fuel endowments (Murphy, 2013; Slingerland and Schut, 2014; Hess and Mai, 2014), international trade (Köhler, 2014); dominant discourses (Chevarria and Pedroso, 2016), behavioural aspects (Chelleri et al., 2016) and flows of international resources via donor interventions (Hess and Mai, 2014; Hansen and Nygaard, 2013; Wieczorek et al., 2015a). Many of the lessons learned are the result of a combination of transitions studies and other disciplines, e.g. time geography (Murphy, 2013) or a participatory approach to development (Ortiz et al., 2012). The aspects that receive the most attention are actors and institutions.

Actors are studied as potential leaders of sustainability transitions, including: users (Rehman et al., 2012, 2010; Patankar et al., 2010), earlier mentioned state (Genus and Nor, 2007; Lawhon, 2012b; Hu et al., 2015; Xu et al., 2016; Xue et al., 2016; Angel and Rock, 2009; Rock et al., 2009), civil society organisations (Slingerland and Schut, 2014; Wakeford, 2012), corporate shareholders (Rock et al., 2009), external, non-profit intermediaries (Neef et al., 2015; Opazo, 2014), higher education (Stephens et al., 2008), non-state stakeholder urban forums (Lawhon, 2012b) and communities (Minh et al., 2014; Mguni et al., 2015; Nastar and Ramasar, 2012). An interesting case concerns religious communities (Mohamad et al., 2012). Owing to their institutional and organisational structure, rituals and formalised establishment, they are found to have a particularly high potential to provide localised resources for broader change. Critical but downplayed in the literature, the actors for developing countries' transitions are donors (Hansen and Nygaard, 2013; Byrne, 2009). While they are expected to provide protection against market selection pressures and mitigate the risks, closer examination reveals that their interventions more often hinder radical change (Hansen and Nygaard, 2013). Campbell and Sallis (2013) make a more general observation that the management of transitions in the developing world would improve if the relevant decisions were made by local social actors, rather than at headquarters in capital cities. This resonates with findings in the developed context on the importance of local and regional actors in establishing effective collaborations and networks that stimulate sustainability transitions (e.g. Späth and Rohracher, 2010, 2012).

Concerning institutions, similarly to arguments made about the developed contexts (e.g. Späth and Rohracher, 2010, 2012; Hansen and Coenen, 2015), it is emphasised that actors configure their institutional settings differently across the world and thus drive change in dissimilar ways (Murphy, 2013; Jolly et al., 2016; Berkhout et al., 2011). In developing and transition economies, informal institutions such as norms, values and cultures play a pivotal role (Sengers and Raven, 2014; Minh et al., 2014; Romijn et al., 2010). They either shape formal institutions or, more often, prevail in cases where formal institutions and markets fail. Minh et al. (2014) gives an example of Vietnam, where people creatively formulate their own rules and routines when formal institutions are too constraining.

3.4. Transnational linkages

Research on transitions has long been criticised for its spatial narrowness (Coenen et al., 2012; Truffer et al., 2015) leading to a number of theoretical and empirical advances (e.g. Lawhon and Murphy, 2012; Wieczorek et al., 2015b). Most studied aspects include place-specificity and its impact on transitions, geography of niche dynamics and inter-organisational relations (Hansen and Coenen, 2015). Systems in developing countries are particularly interesting to investigate in that respect; especially those that are part of global value chains reveal strong transnational characteristics.

Most of the publications analysed here make claims along the convergence and catch-up theories, assuming that (greener or other) technologies are hardly ever developed in less advanced countries (Opazo, 2014; Lachman, 2013). The authors focus therefore on demonstrating the impact and importance of various transnational developments for the operation and shaping of national or local economies (Köhler, 2014; Roy et al., 2013; Rock et al., 2009; Quitzow et al., 2014; Tong and Yan, 2013; Mans, 2014; Helliwell and Tomei, 2016). Taking the examples of Kenyan wind turbines and photovoltaics in Tanzania and Rwanda, Kamp and Vanheule (2015) and Hansen and Nygaard, (2013) even show an emergence of technological niches entirely beyond the analysed country boundaries. However, new ideas about sources and forms of alternative development pathways are beginning to challenge this view (Berkhout et al., 2009a,b; Wieczorek et al., 2015a; Sengers and Raven, 2015). In particular, the scale and space-sensitive systems innovation framework (Raven et al., 2012), contrasts with the standard uses of this perspective (such as by Jiahai et al., 2012a,b; Xue et al., 2012; Sangawongse et al., 2012; Wells and Lin, 2015), allowing more focus on different main sources of innovative activity than developed and company milieus. Raven et al. (2012) mobilise relative proximity to describe niches, regimes and landscape as networks of actors at various degrees of (not only geographical) nearness. These actors create and reconfigure power within the networks, causing knowledge, resources, technologies and innovations to flow. Wieczorek et al. (2015a) and Hansen and Nygaard, (2013) term these diverse cross-border relationships and interactions as transnational linkages. The linkages are the means for actors to complement lacking resources and constitute thereby a major source of socio-technical innovation. While emphasising transnational connectivity, authors also note that studying transition processes from a transnational perspective does not mean that national, local or regional scales are unimportant (Smits, 2015; Muñoz and Wright, 2015). On the contrary, the associated national innovation policies and institutions remain highly significant due to various path dependencies and their key role in harnessing the power of transnational linkages to create new paths (Johnson and Silveira, 2014).

3.5. Regime uniformity

Although regimes (see Fig. 1) may appear superficially to be coherent blocks (and often present themselves that way through spokespersons), there are often internal tensions, disagreements and conflicts of interest (Geels, 2011). These dynamics can affect the type of pathways along which transitions unfold (Smith et. al., 2005; Geels and Schot, 2007).

In the developing world, regimes show a much higher degree of non-uniformity and internal tensions than in Western contexts. They are not always tied to one specific technological configuration but embed a great diversity of modes that can fulfil the same need. Old systems coexist alongside new ones (Berkhout et al., 2009; Furlong, 2014; Sengers and Raven, 2014). Diversity and reliance on different alternatives that work at a particular moment, are used by the society as risk-minimising strategies. In these circumstances, scholars find it difficult to 'establish' fully coherent regimes or groups of individuals who share expectations, beliefs or behaviour (Byrne, 2009; Campbell and Sallis, 2013). The lack of 'sharedness' is also caused by high levels of uncertainty about rules and social networks or the dominance of informal institutions (Genus and Nor, 2007). To deal with that constraint, Ulsrud et al. (2011) and Sengers and Raven (2014), rather than 'applying' any analytical concept, they define the systems and regimes through the eyes of the analysed actors at different societal levels and in different parts of the systems.

3.6. Stability and change

Stability and change are key concepts in transition studies. Although recently views on stability and change have become more nuanced (e.g.; Geels, 2014; Grin et. al., 2010; Hoffman, 2013; Kern, 2011; Meadowcroft, 2011), the dominant view is that socio-technical regimes can be stabilised on a number of dimensions such as infrastructure, technology, or markets (Smith and Raven, 2012). Resistance of incumbent industries and policy makers is the main obstacle in the process of transition, creating inertia and lock-in of regimes (Geels, 2014). Change is an outcome of conflicts, contestations, lobbying, coalition building and bargaining by and between various actors and social groups. To stimulate transitions, activities are considered that can destabilise unsustainable regimes and create windows of opportunity for promising alternatives (Elzen et al., 2004; Turnheim and Geels, 2012, 2013).

People in the developing world however, live in a reality best characterised as a constant state of disrepair: they may have either no, sporadic, and/or poor quality services (Furlong, 2014; Mguni et al., 2015; Gopakumar, 2010). To deal with dysfunctional or absent basic systems of provision, society relies on a variety of alternatives and develops new practices, which become very stable over time (Furlong, 2014). Apart from being non-uniform, regimes in the developing world can therefore also be highly dysfunctional. From a transition perspective, it is thus not entirely clear which dimensions create resistance and what exactly needs to be destabilised (if at all). Such highly dynamic conditions also create uncertainty (Berkhout et al., 2011) and barriers to change (Verbong et al., 2010). Stability and change as key concepts in transition research thus need to be better unpacked in order to usefully describe and suggest ways to go about radical changes in non-Western contexts. For example, is integrating simple and well-known 'mediating' technologies such as efficiency devices in existing socio-technical configurations, suggested by Furlong (2014), a way to achieve significant change? Due to the short term character and technological focus, doesn't such approach lock developing societies into not entirely sustainable trajectories? Verbong et al. (2010) suggest to utilise such 'unserved' spaces as an opportunity to stimulate sustainable development pathways from the start Particular questions thus arise about what is a sustainability transition in those dynamic contexts and what type of governance strategies can stimulate it, but at the same time provide investors and end-users with reliable and stable (institutional) conditions and thereby a degree of security.

3.7. Power

Power has inherently and implicitly been linked to the concept of a regime (Geels, 2014). By definition, being a dominant configuration, a regime is considered the most powerful while its radical change implies power struggles between the regime, niche and landscape forces see Fig. 1(Avelino and Rotmans, 2009). Following critique of this implicit treatment of power and low attention to politics and governance in transitions (e.g. Shove and Walker, 2007; Meadowcroft, 2009, 2011), these themes have increasingly been addressed in sustainability transition studies, resulting in a number of theoretical and empirical advances (Kern and Howlett, 2009; Voß et al., 2006; Hoffman, 2013; Avelino et al., 2016; Avelino and Wittmayer, 2016).

In developing contexts, power is found to be extremely relevant (Lawhon, 2012a,b; Romero-Lankao and Gnatz, 2013; Smits, 2012; Campbell and Sallis, 2013; Byrne, 2009) but the recent advances on power issues in transitions, have not yet been taken into account. The attempt by Avelino and Rotmans (2011) is by far the most valued for offering a framework to enable various 'power exercises' in transitions. Their endeavour is however also criticised for its limitations, biases and risk of over-simplification (Nastar and Ramasar, 2012). Furlong (2014) argues that power relations which preserve the incumbency and regulate transitions are not only the domain of 'system builders' but concern historical and current political and economic actors at various levels. For example donor interventions that distribute aid between countries are increasingly seen as instigators of conflict over resources, interests, rationalities, interpretations and influence between various actors (Hansen and Nygaard, 2013). Tyfield (2014) further criticises the negative view of power and politics in transitions, and the focus on explaining the stability and lock-in of existing systems created by incumbents, as missing the point. Instead, Tyfield et al. (2015) and Tyfield, (2014, p. 588) propose building on Foucault's positive and relational concept of power, "…not possessed and concentrated but constitutive and (asymmetrically) dispersed, not presumptively bad but normatively ambiguous, not just oppressive and destructive, but also productive and ontologically necessary for the construction of all human creations, and not illegitimate until rationally consented to, but strategic and ubiquitous…". Relational view of power is said to offer a better perspective on how power relations supporting certain transition outcomes emerge, how they persist, how they are contested and how they change over time (Lawhon, 2012a; Fry, 2013). Considering power relationally, especially in combination with insights from political economy, is also thought to contribute critical insights into our understanding of transition governance (Lawhon, 2012a,b; Baker and Newel, 2014; Baker, 2015).

3.8. Path dependence

Transition studies focus on showing the mechanisms through which existing rules and structures either enable or constrain actions, or why certain actions are chosen over others. Path dependence is considered a main factor leading to lock-in of regimes, thereby obstructing system change (Grin et al., 2010). Increased attention is given to the role of place-dependence and a variety of place specific factors such as policies, markets, natural landscape features, pre-existing competence base, availability of resource endowments and in particular, the positive impact of resource scarcity on investments in renewables (Bridge et al., 2013; Murphy and Smith, 2013; Späth and Rohracher, 2012)

The analysed literature recognises that path dependence of the contexts in which transitions occur, impacts systemic change in different ways (e.g. Mason, 2009; Mans, 2014; Van Assche et al., 2014; Swilling et al., 2015). In developing societies, the potential for alternative development trajectories is on the one hand, hindered by the need to tackle enduring poverty and social inequalities, past and current practices of injustice including 'colonial and contemporary forms of discriminatory planning' (Furlong, 2014:145), poor knowledge accumulation, flexible institutional embedding, discourse and propaganda (Opazo, 2014; Sengers and Raven, 2014; Fry, 2013; Fatimah et al., 2015). On the other hand however, because developing countries have not always managed to develop a highly organised (energy, road etc.) infrastructure, this frees them from the pressure of replacing it

with other configurations that better facilitate the shift to sustainable systems. This implies different pathways and different strategies may be needed to reinforce such 'transitions'. It also means making choices and avoidance of environmental catch-up and convergence (Berkhout et al., 2011). Infrastructure has a long lifespan; built now will likely last for several decades. It may either reinforce carbon lock-in (Unruh, 2000) or empower societal capacities to embark on more sustainable development pathways (Birch, forthcoming). In the development literature, these themes have, to some extent, been unpacked under the concept of leapfrogging (e.g. Watson and Sauter, 2011) but transition studies, apart from a few exceptions (Schroeder, 2010; Angel and Rock, 2009), have not significantly engaged in these discussions.

3.9. Contextual forces

Van Driel and Schot (2005) term contextual developments as landscape forces (see Fig. 1) and describe them as a set of slow-changing factors such as broad cultural and normative values, long term economic effects like urbanisation and shocks such as wars or crises. Geels and Schot (2007) further argue that the landscape is highly dynamic. Although co-created by the agency of many actors, it remains beyond the immediate reach of the regime and niche actors.

The exogenous and relatively stable character of landscape is found problematic when applying it to the analysis of transitions in developing countries. Equally difficult is its conceptual demarcation (Tyfield, 2014; Campbell and Sallis, 2013) and practical operationalisation (Rock et al., 2009; Campbell and Callis, 2013). For example, Tyfield (2014) shows that especially in modern-day China, which is undergoing a deep 'structural transformation', it is impossible to distinguish between an 'exogenous' auto-mobility landscape and a 'stable' regime. This seems to be because the timescale in which changes occur in emerging economies is incomparably shorter than in the Western context. Other studies (Romijn and Caniels, 2011; Kamp and Vanheule, 2015; Slingerland and Schut, 2014) show that the processes empirically mentioned as landscape developments are not exogenous but result from many actors' actions or are actively mobilised by them to promote their innovations. To specify the historically shaped landscape-type of political and economic processes and their interaction with the regime-internal drivers of change, Nastar (2014), Baker and Newell (2014), Tyfield (2014), Power et al. (2016), Newell and Phillips (2016) enrich the transition perspective with insights from (cultural) political economy, political ecology, energy geographies and Foucault's governmentality approach. Rock et al. (2009) operationalises landscape in Asian countries as overarching industrial development strategies promoted in the post-WWII period. This perspective demonstrates that particularly capitalist developmental states, by being open to trade and investment, and having effective public-private institutions, were able to harness the interaction between global economic forces and local political-economic institutions, values, and regulations that shape an economy, to transform their industrial structures.

3.10. Normative orientation

Although system innovation studies are driven by the environmental rationale of sustainability, little attention has so far been paid to the normative aspects of transitions. Some exceptions (Smith, 2007; Swilling and Annecke, 2012; Striling 2011; Cuppen et al., 2016; Raven et al., 2017) emphasise the strong disagreement about what exactly is sustainable and how to achieve this. The lack of consensus is driven by the contradictory perspectives (Baker, 2016) and interests of actors located in different spatial and time scales.

In developing countries, the contradictions are further amplified. Immediate concerns about social inequalities and the lack of access to modern services (such as sanitation or education) dominate the distant environmental challenges (Opazo, 2014; Sengers and Raven, 2014; Wieczorek et al., 2015a; Romijn et al., 2010). Authors also highlight the confusion about what sustainability and resilience mean or entail in practice (Romero-Lankao and Gnatz, 2013; Gopakumar, 2010). Actors attempt to learn from 'best practices' but discover that no single strategy, however successful in a specific context, is applicable everywhere (Romero-Lankao and Gnatz, 2013; Wigboldus et al., 2016). The reactions to crises are mediated by each nation's economy, environment, institutions and culture. The definition of sustainability or resilience thus varies depending on what social and material factors are interacting. Consequently, actors often present conflicting framings of and approaches to the same sustainability or resilience issues (Romero-Lankao and Gnatz, 2013). This hinders effective decision-making. Some authors thus attempt to enrich transition approaches with insights from other fields such as Life-cycle Assessment, arguing that this helps to evaluate the factual environmental impacts of sustainability transitions (Lebel et al., 2010). Such frameworks however, do not capture the diversity of actors' perspectives and the underlying uncertainties and therefore do not support the participatory governance needed for transitions. To deal with these limitations, Raven et al. (2017) make use of a multicriteria mapping method (Stirling,1999, 2010) to unpack diverse views on sustainability of solar PV pathways in India and Thailand. Authors call for extreme caution in assuming any objective status for the sustainability of innovations, for greater reflection on the normative implications of case study choices, for unpacking of uncertainties and diverse possible socio-technical configurations and for reflexivity about the specific geographical contexts within which the sustainability of transitions is addressed.

3.11. System framing

The starting point for transition research has been the recognition that many global environmental problems cannot be solved by product or process innovations but require a more far-reaching change of the systems which provide human needs (Elzen et al., 2004). Technology plays an important role in modern society and cannot be ignored, but technological change alone is not able to deal effectively with the challenges. It needs to be coupled with equally high-level social, political and cultural change (Elzen and Wieczorek, 2005).

This socio-technical framing of systems is criticised on two levels. First concerns the 'bias' towards (sustainable) technologies and their development from R & D to its socio-institutional embedding' (Opazo, 2014; Swilling et al., 2015). This observation may be driven by the initial writings on SNM geared towards creating markets where green technologies are adopted and reshape the incumbent regimes (e.g. Kemp et al., 1998). Opazo, 2014 argues, in line with the convergence theory, that promising new technologies hardly ever originate from developing countries, due to a lack of capacity, adequate policy frameworks or resources, which require perspectives aimed at the societal embedding of (transferred) technology rather than its development. The second criticism refers to missing links with ecological aspects, material and energy-intensity of economic activities and human-nature relationships. By focusing purely on society-technology interactions, the socio-technical approach is found of little use for understanding transitions of especially agricultural systems on which poor people in the least developed countries are so reliant (Pant, 2014; Schandl et al., 2009; Pant et al., 2014, 2015; Mutoko et al., 2014).

To deal with the theoretical limitations and account for their global impacts, in the context of emerging Asian economies, Schandl et al. (2009) proposes to complement research on a possible transition in socio-technical systems with a broader and ongoing transition from an agrarian to an industrial mode. The mode is framed as a socio-ecological regime – a specific set of rules that regulates the operation of entire social systems and their corresponding biophysical properties. Such socio-ecological regimes can comprise of a specific metabolic profile of economic activities and allow to relate them to environmental impacts. Solving sustainability problems would then require not only a radical change of socio-technical but fore mostly, such socio-ecological

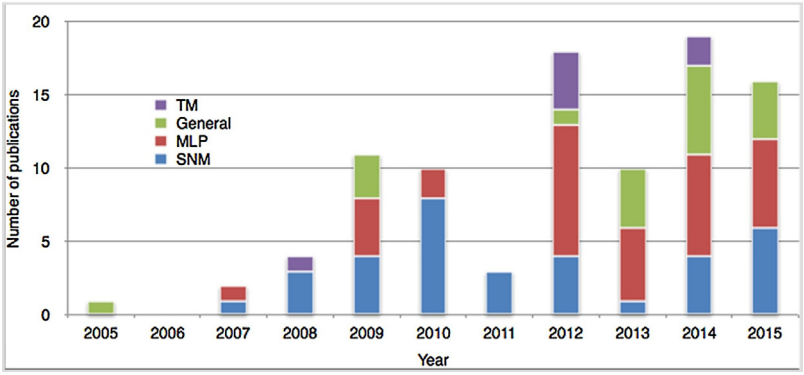

Fig. 2. The number of publications on sustainability transitions in developing countries per year and per framework. General category includes articles on transitions without references to any of the three frameworks (in a sample of 115 analysed documents).

regimes towards sustainability. In the context of the resource-rich, exporting African countries, Swilling (2013) suggest a framework that connects three interactive long-wave dynamics: socio-metabolic transitions, technological revolutions and long-term global development cycles (that focus on cycles of economic growth, prices, crises and creative destruction). This perspective is said to better trace the reasons and thus aid the solutions for current global challenges.

4. Discussion

4.1. What have we learnt?

First, while the transition approach, and in particular the analysed frameworks, are found useful for analysing the interplay of factors that motivate or hinder transitions to sustainability in less economically advanced countries, this review clearly demonstrates that the historical and contemporary reality of the developing and developed world differs significantly. The patterns are therefore difficult to compare and make learning from each other not as straightforward as one might expect. Marcotullio (2005) in describing emerging Asia concluded that changes occurring in that part of the world are faster, occur more simultaneously and at an earlier stage of GDP. This suggests that the timing, severity, complexity and multiplicity of the problems are nowhere near the scale of developments experienced by the Western world. Think how we have framed environmental problems and their potential solutions in the past 70 years in Europe. We have moved from end-of-pipe solutions for environmental degradation through process and product innovations, to system innovations to address global societal challenges (Wieczorek and Berkhout, 2009; Schot and Steinmueller, 2016). Developing African and Asian countries face all these problems at the same time and seem to require all possible solutions. This complexity might be one of the reasons why the 'mechanical' application of the MLP framework to that reality is difficult and why MLP analytical levels have become blurred. Key to successful transfer of these theories is therefore recognition of the specificity of the various socio-economic, political and historical contexts and a different, more reflexive operationalisation of the various approaches based on treating the transition concepts such as niches, regimes, landscape, stability etc. as empirical questions rather than assumptions (Geels, 2011).

Second, interestingly, many of the issues outlined in Section 3, although identified for developing countries, are not confined to those contexts. Developing environments seem to amplify the transnational nature of regimes, the important role of institutions in the upscaling of experiments, difficulties with demarcation and operationalisation of landscape forces or the contested nature of sustainability as a normative orientation of transitions. These issues however are also relevant for the Western world transitions.[3] For example, Smith (2007) highlighted the blurred distinction between niches, regimes and landscapes; Raven et al. (2012) and Jørgensen (2012) argued for a less exogenous treatment of landscapes; Smith et al. (2005) criticised the dominant view of socio-technical regimes as homogenous and monolithic. Research on developing countries' transitions thus raises new research questions for both contexts.

Third, it is true that many of the insights analysed here from a transition perspective, have also been discussed in the development literature. For example, the issue of transnational connectivity – the implications of openness to international trade and technology transfer, were discussed in the leapfrogging and catch-up literature by e.g. Watson and Sauter (2011). Bell and Pavitt (1993) discussed insights in local capability formation. Issues with weak formal institutions leading to reliance on informal institutions in bottom-of-the-pyramid environments have been discussed by e.g. De Soto (2000) and London and Hart (2004). Evidence of the lack of effectiveness of donor interventions in least developed countries was studied by Easterly (2009). What transition studies add to these debates is the way of framing of the complex processes, and therefore also ways of seeing the bigger, systemic picture, making the context and its impact more explicit and articulated, factors which development studies have not considered in great length.[4]

Finally, even though the long held view has been that transition research only focused on the developed world, this review of 115 publications[5] proves this is not the case anymore (Fig. 2).

A characteristic feature of this set is some bias towards producers/suppliers and hence technological niches in energy sector (see Fig. 3). There is less focus on transitions in behaviour, social innovations, practices and policy. The empirical fields of agriculture, mobility and cities are expanding rapidly.

The strong Asian orientation (Fig. 4) has its own path-dependence. In 2004/5, when the Dutch Knowledge Network on System Innovation (KSI) was set up, the IHDP Industrial Transformation programme was responsible for internationalising the main theoretical insights. Because of the sustainability focus and anticipated impact of developments in Asia, research focused on that area and resulted in several articles and special issues (e.g. Berkhout et al., 2010, 2011). Judging by the contributions to the annual transitions conferences ever since 2015, the diversity of studied contexts, themes and authorship is growing.

While not every author makes an effort to reflect on the used framework, many scholars make links to other theories and disciplines to fill in the gaps and deal with the various deficiencies of transition approaches (Table 2). This theoretical cross-fertilisation and empirical testing are positive and enriching for analytical refinement. Thanks to this dialogue, which continues in the entire field of transition studies, we can cease criticising MLP for being spatially insensitive or missing agency, power and politics.

[3] My thanks to a reviewer for pointing this out.

[4] Again my thanks to a reviewer for pointing this out.

[5] Markard et al. (2012) identified a total of 540 articles for the entire field up till 2011.

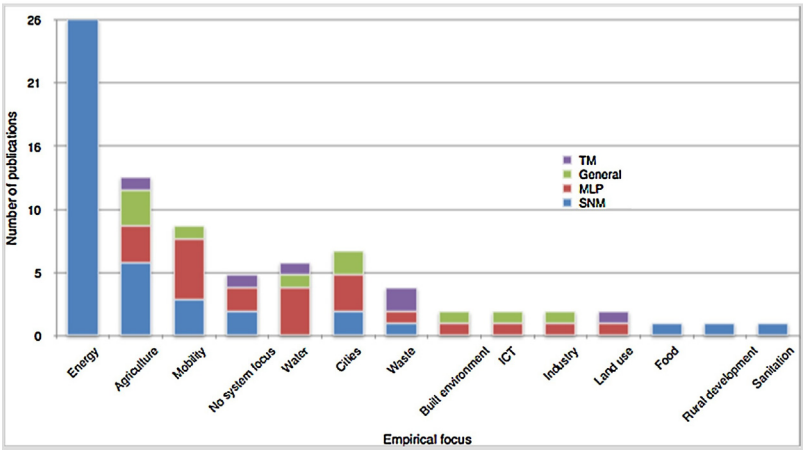

Fig. 3. Empirical focus of the 115 analysed publications.

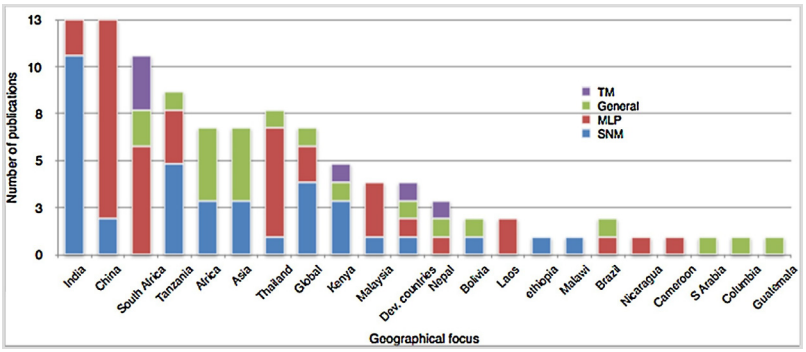

Fig. 4. Geographical focus of the 115 analysed publications.

Table 2
Overview of connections to various strands of literature in the 115 analysed documents.

SNM	MLP	TM	General
• Cultural and social constructionist approaches to institutions • Urban environmental evolution • Supply chain management • Social Network Analysis • Sociology of conflict • Development studies • Learning-based development approaches • Social entrepreneurship • Action research • Economics	• Foucauldian-inspired cultural political economy perspective • Climate change adaptation • Participative approach to development • Political ecology • Lead markets • LCA • Global environmental governance • Political economy • Philosophy • Cultural studies • Energy geography • People-centred approaches	• Relational political ecological perspective • Environmental governance • Innovation studies • Adaptive management • Evolutionary theory	• Theories of growth, convergence and catch-up • Social, ecological systems theory • (Economic/Time/Human) Geography • Socio-metabolic flows • Technological revolutions • Discursive regulation • Learning-based development approaches • Modelling studies • Long wave theory • Anthropology • STS • Ecology • Political economy • Policy studies

4.2. Policy implications

One of the main reasons for analysing earlier and ongoing transformative changes from a socio-technical perspective, is to learn from the past, identify patterns of change and indicate possible intervention points that would inspire transformative practice and strategy development (Grin et al., 2010). Although more focused on understanding change, applying transition approaches to analyse developing countries' transitions, reveals several issues concerning policy at various levels (see Table 3[6] for summary).

The insights identified in Section 3 emphasise the critical importance of experimentation and the experiments' local embeddedness for their effective upscaling. What becomes obvious, in line with observations by Lema and Lema (2012), Urban et al. (2015), Tigabu et al. (2016); Marquardt, (2015), is that the classical technology transfer mechanisms are no longer effective and projects created by international organisations fail to even survive beyond their official duration. The main reason for this failure is the lack of meaningful engagement with place-specific cultures, power relations and infrastructures. The often short-term donor interventions are seen by the recipients as risky and representing external interests. Amars et al. (2016, p. 16) even calls them 'tools for northern neo-colonial oppression'. The programmes embody new practices that are difficult to accept due to low local capacity and a general lack of interest in any policy change; ruled by their

[6] Policy implications expressed here do not specify the relevant policy level to which they apply.

Table 3
Summary of main insights and their policy relevance.

Major theme	Insights	Policy implication
Experimentsand upscaling	There emerge transnational sustainability experiments that embody novel sources of capability-formation other than industrialised firms which challenges convergence theories.	Move away from technology transfer type of aid. Revise subsidy policies. Support and utilise the potential of emergent experiments stimulating development pathways that are less material, energy and pollution-intensive.
	Vertical and horizontal linkages are important for upscaling of experiments.	Embed new projects by making links with practices, power and infrastructures to actively facilitate upscaling. Avoid externalities − e.g. shifting pollution elsewhere.
	Definition of sustainability experiments is useful but needs further specification to create an effective design for developing countries.	Learn from development studies to design transformative experiments/ interventions in a way that they can be sustained by local communities once 'protection' in the form of aid is withdrawn.
Transnational linkages	Regime and niche actors are increasingly transnationally connected and there are technology, capital and knowledge flows. However, local assets and policies still play an important role.	Utilise transnational connectivity to access foreign assets which can help stimulate sustainability-oriented innovations as starting point for creating alternative pathways.
Regime uniformity	Regimes in developing countries are less uniform than in the Western world. Old technologies exist alongside new ones, providing the same service.	Consider the various degrees of disaggregation and fragmentation of regimes as a basis for the design of transformative policies.
Stability and change	Stability does not necessarily obstruct regime transformation in developing countries. Many systems are absent or highly dysfunctional.	Consider transformative policy based on filling 'unserved spaces' with sustainable alternatives and providing a stable institutional framework that facilitates social entrepreneurship.
Path-dependence	Some aspects of path-dependence in developing countries (colonial past) form barriers to sustainability transitions, while underdeveloped or absent fossil fuel-based infrastructures provide opportunities.	Utilise the space created by missing infrastructure to get on a sustainability path. Especially relevant for oil importing countries that could reduce their energy dependence and gain energy security.
	Institutional contexts are place specific	Do not blindly 'copy' policies and 'best practices' from one context to another.
Contextual forces	Landscape forces are not as exogenous as theory predicts and can have a direct impact or be deliberately mobilised by niche actors.	Take better and more active account of historical developments, utilise local strengths and global forces to stimulate systemic shifts to sustainability.
Normative orientation	Sustainability perception differs across societies, causing disagreements about problems and their solutions.	Apply more participatory approaches to decision making, to better appreciate and utilise the diversity of opinions and their rationale.

logic, donors create their own regimes. However, experience shows that interventions are most powerful when initiated 'from within' and demand driven. The emerging sustainability experiments initiated by local actors but informed by international developments, are a great example of such dynamics that might be built upon. Additionally they give a promise of different, more sustainable development pathways.

In that light, international organisations might need to reconsider the ways they provide support to developing countries and how they design 'projects': away from interventions isolated in space and time and involving selected actors, towards stimulating social entrepreneurship, supporting the creation of new business models and assisting local actors in setting up projects that meet their own needs. On the part of national or regional governments, this requires a better understanding of landscape dynamics, and more considered policy-making to harness the global forces for forming local competencies. State actors can consider taking more advantage of historical developments, combining foreign public and private finance with domestic interests and reorienting these various forces to steer transitions. Importantly, policymakers at every level need to take a variety of interrelated factors into account to define strategies for transition governance. These include issues such as the lack of institutional security, the variety of path dependencies (infrastructural, institutional, cultural, economic), the hybrid character of incumbent systems and the changing balance of powers or diverging perspectives on what is a sustainable solution in the given context.

4.3. Possible ways forward

Based on the review, a number of potential new avenues of research can be suggested:

Challenging convergence and catch-up theories by exploring alternative development pathways and their drivers. Particularly interesting would be to empirically verify whether bottom up sustainability-oriented local activities provide reliable sources of more sustainable pathways and new innovation models. Close collaboration with development studies on the theme of structural transformation, that many developing countries undergo, would enable a better understanding of the dynamic developments at landscape and regime level, and their orientation.

Reconsidering concepts of stability and homogeneity of regimes. Can the definition of regimes be extended to encompass differing grades of regimes' uniformity, ranging from highly monolithic to highly hybrid configurations? On which dimensions are the different configurations stabilised and how does the level of development influence the lock-in patterns? How does this influence our current thinking about patterns of radical change towards sustainability? Is transition always based on replacing one regime with another? How to frame a transition to sustainability when there is an absence of certain socio-technical systems? What are the potential transformation pathways in the various dynamic set-ups?

Unpacking or nuancing the 'exogenous' character and actual impact of landscape factors, in particular how and why actors deal with various developments: do they actively mobilise them to support their work on alternative niches? How do they do that? What strategies are deployed and do they differ per context? How can historical landscape developments (of developing Asia or Africa) be harnessed to motivate shifts to sustainability?

Even though the process of upscaling experiments as well as its drivers and barriers are well described in theory, practitioners and policymakers struggle to implement these lessons in practice. How should sustainability-oriented projects be designed and embedded in developed or developing contexts, so that they factually bring about radical change? Which mechanism can stimulate upscaling and accelerate transitions? What role does transnational connectivity play? How should this globally connected process be governed? How do the strategies differ depending on context?

Schot and Steinmueller (2016) suggest that addressing accumulated social and ecological challenges requires a transformative policy, one that will support the radical changes not only in socio-technical systems but also in *meta*-rules underlying their functioning. The question however is, what type of transformative policy is able to harness this dynamics and the place-based path dependencies in developing countries

and motivate deep transition. Are state actors of developing countries ready to consider another progressive but very western idea and embark on what in their view presents as a risky endeavour?

5. Conclusions

This review, although systematic, is of an indicative character and does not aim to be exhaustive, for several reasons. Firstly, there is an ongoing and inconclusive debate in transition studies about the contours of this field. Exercises like this, hopefully contribute to a debate about the definition of the field. Secondly, there are other 'transition frameworks' such as Technological Innovation Systems (Bergek et al., 2008; Hekkert et al., 2007) that are not included in this review. A screen of ca 50 publications on TIS in developing countries shows that this approach originates from a different scholarly thought than MLP and SNM. Although used by some in the context of transitions, it is not aiming to clarify broader patterns of transformation but diffusion of particular technologies. Its usefulness in the developing contexts is particularly high because it provides an easy match with the convergence and catch up theories. Thirdly, developing countries are just one type of non-Western context that can be investigated for theoretical reflection. Transitions to sustainability in countries such as Taiwan or Singapore have been studied but do not form part of this review. Finally, the analysed literature covers a decade during which transition studies progressed simultaneously on both fronts. A degree of cross-fertilisation was occurring already on the way.

The identified lessons confirm the middle range character of the transition theory and verify the contingency of the three frameworks. The specific advantage sustainability transition studies have over e.g. economic geography, political economy or development studies is that they offer a systemic and socio-technical perspective on radical change, in the context of which, a great variety of specific questions can be asked. Even though the three analysed frameworks do not provide a detailed view of some micro processes, they are sufficiently broad to be complemented with other approaches and models.

The identified lessons are not revolutionary in character. None of the aspects of the socio-technical transition theory nor its concepts have been 'falsified'. On the contrary, the three frameworks are found useful for considering the complex ways in which macro-scale economic, political, social, and environmental factors, meso-scale networks and institutions, and micro-scale developments co-evolve and co-determine each another in other than Western contexts. What this review makes clear, is that transferring the approaches to analyse other milieus requires care and reflexivity and raises new research questions for both contexts. Moreover, problems of the developing countries are not new, they have been the focus of the development studies scholarship although viewed differently. Further engagement with this strand of literature could prevent transition research from cognitive lock-in and allow for a productive cross-fertilisation.

In terms of policy suggestion, the most prominent ones emerging from this review are: for international organisations and donors to rethink their ways of supporting developing countries; for local and national governments to design policies that take better account of the interplay of global forces and local endowments; and for all actors including industrial leaders, civil organisations and individuals to focus more on entrepreneurship and taking action by stimulating new, smarter business models development that make their bottom-up innovations less dependent on unstable institutional conditions.

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