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Utilising Systems Mapping for Understanding the Contradictions of Sustainable Consumption and Economic Growth

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Abstract

The paper aims to present how the usage of systems thinking, in particular as participatory construction of causal loop diagrams (CLDs), can contribute to a systemic understanding of sustainable consumption. In the framework of an FP7 project titled RESPONDER we are testing the usage of CLDs for knowledge brokerage. Building on participatory modelling approaches and applications we developed a method of 'participatory systems mapping' (PSM) in which CLDs serve as boundary objects and enable co-creation of knowledge. The paper describes how engaging with CLDs can produce specific types of insights that together support a systemic, complex and multi-perspectival understanding of a given problem and thereby can effectively foster learning and help formulation of effective policies for sustainability.

Keywords

sustainable consumption, economic growth, knowledge brokerage, systems thinking, causal loop diagrams, participatory systems mapping

1 Introduction

When the Brundtland report popularised the concept of 'sustainable development' in 1987, it also emphasised the need for developing more sustainable consumption patterns: "Sustainable development requires that those who are more affluent adopt lifestyles within the planet's ecological means" (WCED, 1987: 9). The commitment to sustainable consumption has been confirmed at the 1992 Earth Summit in Rio, and in a number of programmes initiated by international organisations and governments at all levels. Nevertheless, government action on sustainable consumption focuses on the individual consumer (perhaps using misleading models of consumer behaviour) and on improving environmental efficiency of consumption rather than addressing scale issues or the social context and systemic dimensions. Over the last decade several strands of research on sustainable consumption (particularly sociological and anthropological research) have provided evidence which suggests that this dominant policy approach might be the reason for the relatively modest success of sustainable consumption initiatives.

As a contribution to the discussion we are testing the usage of systems thinking methods for the purpose of knowledge brokerage between science and policy aimed to help 'manage the contradictions of sustainable consumption and economic growth'. The project *Linking Research and Policy Making for Managing the Contradictions of Sustainable Consumption and Economic Growth* (acronym RESPONDER) is one of the knowledge brokerage (KB) projects funded by the European Commission through the Seventh Framework Program for Research and Technological Development (FP7) to increase use of available evidence and scientific expertise in sustainable development and environmental policy making. RESPONDER attempts to bridge not only the science–policy gap but also the 'pro-growth'–'beyond growth' discourse gap by recognising and linking four communities: 'pro-growth' scientists, 'pro-growth' policy makers, 'beyond-growth' scientists and 'beyond-growth' policy makers. This paper aims to present how the method of participatory systems mapping, developed in the project, can produce particular insights into problems related to sustainable consumption which lead towards a more complex and systemic understanding.

The next section introduces the discursive context of the RESPONDER project and presents our definition of sustainable consumption. The third section describes our systems thinking approach: the method of participatory systems mapping (PSM), developed for the purposes of the project, is explained and situated in the organisation of project's tasks and events. The fourth section provides an overview of four different ways of engaging with CLDs and demonstrates the different types of insight produced. The fifth section is devoted to conclusions.

2 The competing discourses of sustainable consumption

Over the 1990s and 2000s a number of programmes on sustainable consumption has been initiated by international organisations such as UN or OECD as well as by a number of national governments and the European Union (Fuchs and Lorek, 2005; Berg, 2011; Fuchs, forthcoming). Most of these programmes share the same basic understandings and, contrary to the call of the Brundtland Report, are quite far from any serious challenge to the lifestyles of the affluent. First of all, sustainable consumption is not seen to be in contradiction with continued economic growth in the rich countries, and there is no mention of reserving consumption growth for poor people. As UNEP states in 2000: "sustainable consumption is not about consuming less, it is about consuming differently, consuming efficiently, and having an improved quality of life" (UNEP and CDG, 2000). The policy documents on sustainable consumption stay within the framework of the ecological modernisation discourse that emphasises win-win strategies: consumption can become more sustainable, new business opportunities emerge, and quality of life improve, all at the same time. This should be achieved by increasing the resource efficiency of consumption, encouraged mainly by market-based policy measures. Labelling of green products combined with information campaigns should help consumers to make informed choices and thus make it profitable for business to provide green products. Simultaneously, environmental taxation of resources, in particular energy and water, and of emissions of polluting substances could promote resource efficiency and reduce pollution. The actual toolbox included other instruments like direct regulation (bans on problematic substances, tightening of building regulations) and subsidies to consumers, e.g. for insulation, but direct regulation was not promoted as a part of the

win-win repertoire (Christensen et al., 2007). Politically, it was an attractive strategy to translate the alleged consumer sovereignty in free markets to consumer responsibility: if consumption does not become more sustainable, consumers can be blamed. The focus on improving the efficiency of consumption has been termed ‘weak sustainable consumption’ (used by Fuchs and Lorek, 2005, as a differentiation from ‘strong sustainable consumption’ which focuses on the pursuit of fundamental shifts in consumption patterns and reduced levels of consumption in the rich countries).

Considering the results of the first twenty years of consumer-oriented environmental policies, results have surely been achieved. Nevertheless, there are grounds for criticism. For instance, the combination of compulsory energy labelling, energy taxes and information campaigns has increased the efficiency of electrical appliances significantly, and various measures have reduced heat consumption per square meter. At the same time, however, critics point to an increase in the number of appliances and the area of heated space that counteract the achieved energy savings. In other cases, like transport and travelling, it has not been politically acceptable to follow the ‘recipe’: since mobility is considered decisive for economic growth and personal freedom, economic instruments have not been applied effectively, and energy consumption has increased considerably. Many areas of consumption are not addressed by environmental policies, and consumer-oriented environmental policies have not in any way questioned the continued rise in material living standards, the ongoing renewal of consumer goods, or the costly individualisation of consumption.

A new and related field of research developed over the last 20 years and interacted with policy making (for anthologies see e.g. Princen et al., 2002; Jackson, 2006; Reisch and Røpke, 2004). It has collected knowledge on environmental impacts of consumption, with the consumption clusters of food, mobility and housing identified as having particularly large impacts (Hertwich, 2006). A lot of research applied an individualistic perspective and concentrated on the understanding of consumer behaviour, trying to explain the attitude–behaviour gap and investigating the results of various interventions like taxes, eco-labels and information campaigns. Some research saw a solution in the identification of different consumer groups and lifestyles and addressing them in different ways. Nevertheless, under ‘green consumption’ it is perfectly possible for consumers to demonstrate their ‘greenness’ by carrying out a large number of token green practices and simultaneously increase their

environmental impacts considerably. Large segments of consumers have developed a sort of 'compartmentalisation' where only some categories of consumption are considered in environmental terms, while much ordinary consumption and increases of normal standards go unnoticed.

Concurrently with the individualistic-oriented consumer research, more sociological and anthropological perspectives were developed (Gronow and Warde, 2001; Southerton et al., 2004). Here the embeddedness of consumption activities within wider social, economic and technological frameworks was emphasised, and the interplay between systems of provision and consumption practices was explored. So far this strand of research has not been influential in policymaking, but this may be about to change. Maybe the limited results of the win-win strategies in terms of the overall environmental impacts of consumption have contributed to a search for broader approaches. The individualistic-oriented research increasingly tries to take 'context' into account (Thøgersen and Grønhøj, 2010), and sociologists try to develop more policy-oriented advice that goes beyond the traditional ABC (attitude–behaviour–choice) approach (Shove, 2010). Simultaneously, bottom-up experiments with more sustainable consumption and production patterns emerge and call for studies on the possibilities for scaling up (Seyfang, 2009).

Concepts which roughly correspond to the directions of these strands have been developed also in other sustainability literatures. It is possible to organise the literatures into a discourse focusing on the individual and 'weak' sustainability (with concepts of ecological modernisation, green consumption (Princen et al., 2002), responsible consumerism, or virtuous circle (Hobson, 2002: 132)), a discourse focusing on the individual and 'strong' sustainability (e.g. voluntary simplicity), and a discourse focusing on the social/systemic dimensions and 'strong' sustainability (de-commodification, or bioregionalism (Sale, 1985)). The RESPONDER project can be seen as tied to the last discourse. First of all, the challenge of sustainable consumption is considered in a global perspective where the focus on improved efficiency in consumption is replaced by 'strong sustainable consumption'. Sustainable consumption is thus characterised along three objectives: a reduction of the overall consumption of resources to steer the socioeconomic system away from natural limits; the ethical challenge of redistribution of resource appropriation from rich to poor within and between nations; and the striving to achieve well-being, quality of life or a 'good life' (Buen Vivir) (see Scholl, 2011). Second,

consumers are not only considered in the role of buyers on a market, but also as practitioners that carry out meaningful practices and, at the same time, fulfil roles in broader socio-technical systems. Nevertheless, we do not push for a specific understanding, but rather expect that the mapping exercises expose a plurality of systemic aspects to facilitate policy-relevant learning.

3 Systems thinking and the method of participatory systems mapping (PSM)

Systems thinking is a discipline developed from feedback concepts of cybernetics and servomechanism engineering theory (Senge, 1990). It provides a framework for holistic thinking while addressing complex societal issues. The core of systems thinking is seeing 'wholes' instead of 'parts', making sense of interrelationships between system components to understand what drives dynamic behaviour. Richmond (1993) advanced a set of critical thinking skills which cater for more holistic policy-making processes, including: i) dynamic thinking (the ability to deduce dynamic behaviour patterns rather than focusing on events), ii) closed-loop thinking (the ability to think in feedback terms leading to recognition of process interdependencies and endogenous causes of systemic change), and iii) operational thinking (the ability to understand the physical processes and 'how things really work'). Research related to natural resource management, ecological economics and sustainable development was attracted to systems thinking since the end of 1960s, and particularly since the publication of *The Limits to Growth* (Meadows et al., 1972). In the area of sustainable consumption, the importance of systems thinking has been increasingly recognised over the recent years (see, e.g., Klingert, 1998; Geels et al., 2008; Timmer et al., 2009a, 2009b; Mont and Power, 2010; Soderquist, 2010; Prinet, 2011). Nevertheless, as of now, a more thorough application of systems thinking is quite rare (see, e.g., Nemecskeri et al., 2008; Jackson, 2009; Green et al., 2010).

Approaches involving clients in systems thinking, applied since the 1970s, have over recent years evolved into, among others, group model building (Vennix, 1996) and mediated modelling (van den Belt, 2004). While providing structured platforms for participation and active engagement of inter-organisational stakeholder groups in policy and decision-making processes, these methods foster co-production of knowledge and group learning as outcomes of the modelling process (Videira et al.,

2009). They constitute settings which enable deliberation among participants and stimulate the development of critical thinking skills, such as the recognition of interconnections and feedback processes. In recent years, these methods have been increasingly used in the context of public policy making on natural resources (e.g. Hare et al., 2003; FLUF, 2010; van den Belt et al., 2010).

Causal loop diagrams (CLDs), shaped in particular by systems dynamics and cybernetics, are probably the most-utilised systems-thinking visualisation tool. Two widely recognised uses of CLDs are the transformation of verbal descriptions into feedback structure during early stages of model conceptualisation (Goodman, 1974), and the presentation of a 'distilled' understanding at the end of the whole modelling process (Morecroft, 1982). Since an underlying principle of systems thinking is that the behaviour of a system is the result of the structure of its elements, CLDs provide an endogenous explanation for observed behaviour. In RESPONDER we intend to test the use of CLDs for KB; we use CLDs as boundary objects (Cash et al., 2003) to (i) transform perceptions and mental models of individuals and groups into a causal and feedback structure, (ii) expand the boundary of thinking by enabling exploration and exchange of knowledge and paradigmatic and value positions accepted in various communities in the process, (iii) identify knowledge gaps through comparison with evidence-based and systematised knowledge, and (iv) formulate hypotheses about causes and effects and insights regarding system's behaviour, and identify potential leverage points.

In the RESPONDER project we organise a number of thematic events in which the participants representing all four target communities engage with CLDs. At the time of this writing we were able to reflect on experience from workshops devoted to sustainable food consumption, sustainable mobility, sustainable housing and household saving and debt (sustainable finance); our findings will be demonstrated on an example from the mobility area. For the workshops we developed a method of 'participatory systems mapping' (PSM) building on participatory modelling approaches and applications (see Richardson and Andersen, 1995, Vennix et al., 1992; van den Belt, 2004; Videira et al., 2009). Since its inception we have tested the method on about 30 occasions in group sizes of 6 to 18 participants (excluding the facilitator). Application of PSM (see Figure 1) can best be described as the preparation and execution of a facilitated group process of development of causal loop diagrams to provide insights into a particular problematic issue and enable knowledge exchange.

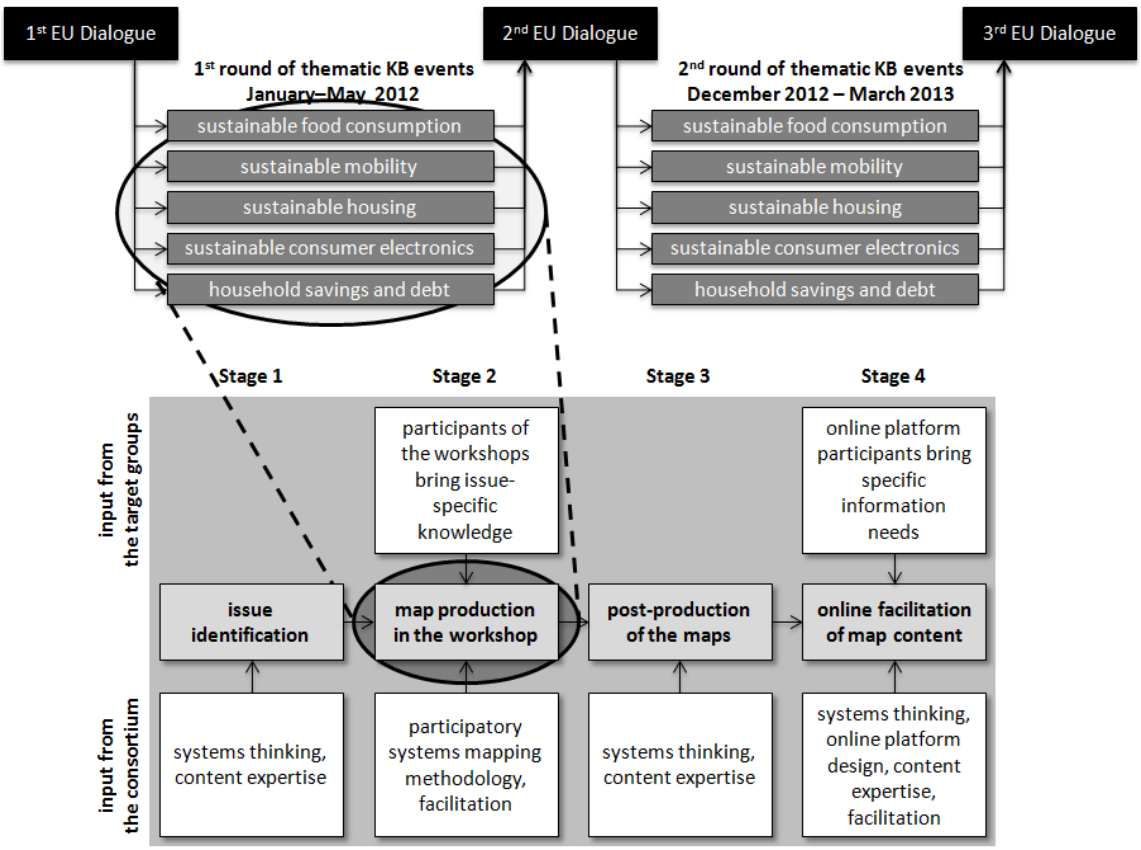

Figure 1. Structure of the RESPONDER events and of the CLD engagement process.

We have chosen to formulate a set of problem issues for each consumption area prior to the workshops. Each problem issue links sustainable consumption with macroeconomic (growth-related) concerns and is formulated as a guiding question which helps to manage the system boundary during the mapping process. The mapping itself was exploratory and (in the first round of events) diagnostic, i.e. aiming to describe the problems in their current situations and institutional contexts. The CLDs are constructed 'physically', meaning with sticky index cards placed on a large sheet of paper. Following the workshop the maps are digitalised and 'cleaned up' by removing inconsistencies and duplicities and correcting originally under-developed system structures. The processed CLDs will be placed in the RESPONDER online knowledge brokerage platform, enabling further interactive engagement.

Causal loop diagrams are expressed in a formal language originating in systems dynamics (Forrester, 1968) and cybernetics (Wiener, 1948; Ashby, 1956; Bateson, 1972). They depict causal relations between selected variables, focusing on positive and negative feedback loops and development trends. Causal relationships (positive or negative) are depicted as arrows, marked with a double slash sign whenever a time delay slows down the response.

We understand systems as purposive, transcending the subject/object boundary by connecting relevant elements of individuals, social systems and the natural environment through pathways and feedback loops (see also the 'theory of the mind' by Bateson, 1972). Systems thinking thus typically does not concern itself with the question of agency; agents are typically *hidden* in the assumptions or in the system goals and strategies. Furthermore, institutions (rules, norms etc.) are also rarely explicitly present; however, to a large extent they *enable* the depicted causal connections. Therefore structure can be understood as 'objectively given' by material and institutional conditions. Nevertheless, in relation to the context of participation and knowledge brokerage, we respect Churchman's (1970) understanding of boundaries as 'social or personal constructs that define the limits of the knowledge that is to be taken as pertinent in an analysis', acknowledging that '[w]here exactly boundaries are constructed, and what the values are that guide the construction, will determine how issues are seen and what actions will be taken' (Midgley, 2000: 35–36). The participatory design is supposed to address the valid concern of Dryzek (2005) of a technocratic elite of systems thinkers dictating societal solutions based on impenetrable computer models. PSM serves to provide an explicit picture of how participants see the system in positivist terms, and empower them to think of and deliberate on viable solutions. Furthermore, it should enable a discussion of boundaries (i.e. where lies the power to draw boundaries), as well as the assumptions and institutions behind the system's structure. A specific type of boundary is the timeframe of the depicted system to which the stability of its structure is related; we understand the CLDs as 'snapshots' of systems at certain points in time. Systems continually evolve and change their structures, and sometimes they collapse and are reorganised radically (see, e.g., the adaptive cycle; Holling, 2001). More abstract system representations tend to be more useful for depicting longer time frames than detailed CLDs representing concrete situations.

4 Achieving different types of insight with CLDs: a discussion

The following sub-sections demonstrate some of the 'lenses' for thinking about CLDs and highlight what types of insight and learning effects they support.

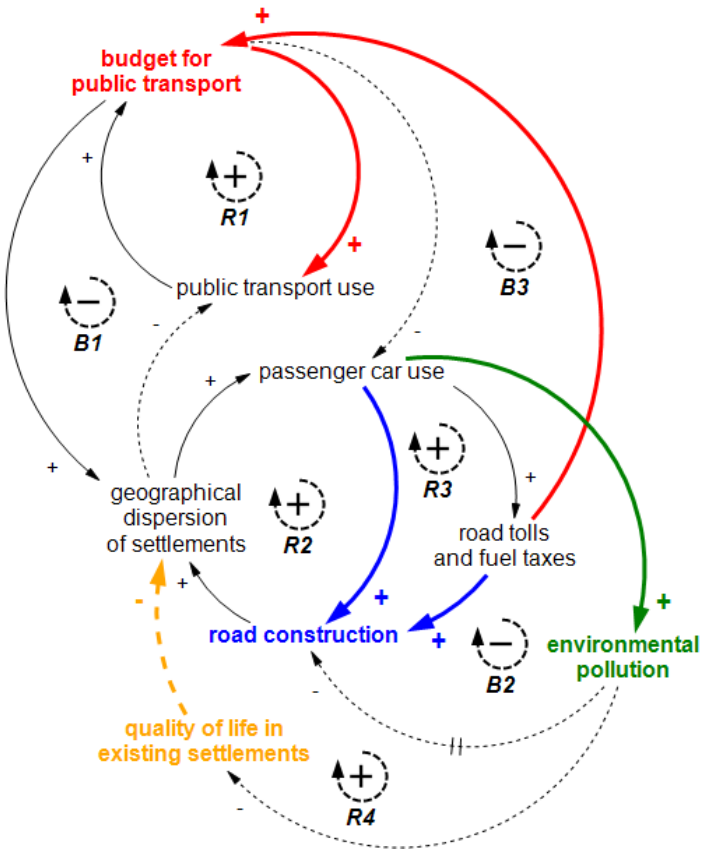

Figure 2. Public transport use vs. passenger car use map

Closed-loop thinking is a ‘lens’ which enables to think about interrelationships between feedback loops. Thereby it helps to understand and infer behaviour of systems over time. The map in Figure 2 shows a simplified excerpt from a system map from the mobility consumption area, mapping the issue “How does road construction influence transport volume and modal split?”. The excerpt highlights dynamic tensions between public transport use and passenger car use. For the sake of brevity a number of various variables is not included in the map (e.g. factors inhibiting switching from car use to public transport such as the symbolic value of private car and its use, population size, urbanisation structure, household incomes etc.) and many of the causal relationships are simplified (e.g. between budget and public transport use).

Even though inferring behaviour is not reliable without a simulation, CLDs still invite discussion on the relative strength of individual feedback loops and development trends. As an example, it could be theorised that the reinforcing loops related to passenger car use (R2, R3 and R4) are together much

more powerful than the balancing loop B2, and that therefore the resulting ‘momentum’ of the passenger car use cluster will be stronger than that of the cluster related to public transport (which has one moderately strong reinforcing loop and one moderately strong balancing loop). As a probable result, the geographical dispersion of settlements, which seems to be the most crucial variable in the map, would, unless meeting limits not depicted in the map, continually grow and cause a migration of public transport users to car users at an accelerating rate. The map also expresses several (surprising) statements:

- The only factors that counterbalance the growth of passenger car use are attractiveness and availability of public transport and the effect of pollution on road construction (through political mobilisation etc.). This opens a discussion on further possible balancing factors.
- Increasing availability of public transport would result in the settlements being more dispersed than they would otherwise have been and this would push public transport use down (with simultaneous growth of car use).
- The environmental pollution caused by car use contributes to further growth of car use: higher car use causes the quality of life in existing settlements be lower than it would otherwise have been, resulting in people moving out into ‘quieter’ or ‘calmer’ areas, and thereby contributing to further growth of the geographical dispersion of settlements which, unfortunately, additionally contributes to an increase in car use.
- Decreasing relative environmental impacts of car use actually worsens the problem: it weakens a counterforce to road construction, thereby leading to an increase of the scale of the problem.

Complementary to closed-loop thinking, it is possible to acquire a more detailed insight by examining variables critical for the system structure (such as the geographical dispersion of settlements in Figure 2) in more detail. A visualisation such as the one depicted in Figure 3 facilitates a discussion about interrelationships between influencing factors: Are the depicted causal factors sufficient to explain the behaviour of the variable? Are factors complementary (i.e. a multiplicative relationship) or substitutive (an additive relationship)? Are the functions between individual factors and well-being linear? What are the trade-offs between factors? Are some factors conditional or

inhibitive to other factors' effects? Is the effect of a factor dependent on an additional variable? Furthermore, what scientific evidence exists for particular causal relationships?

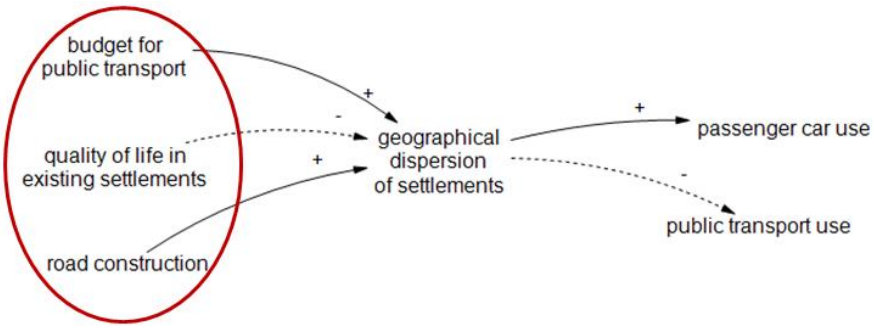

Figure 3. Geographical dispersion of settlements in focus

A third 'lens' consists of attempting to visualise different discourses, mental models or strategies to tackle the problem issue in a given CLD. This can be done by visualising: i) different goals in the system, associated with different paradigms; ii) visualising how an issue is defined and which causal links and feedback loops are perceived as dominant in different paradigms; iii) visualising different strategies (as we did with the use of the different colours in Figure 2). It is even quite possible that individuals and communities promoting the various strategies (and having unique discourses and mental models) would have a different perspective on the causal structure of the system, i.e. they might not perceive significant variables, relationships or leverage points, or not expect a number of side effects. Integration of different mental models or strategies, even though challenging, might bring a range of possible insights. In Figure 2, we represented the following strategies adopted to combat the negative effects of growing car use (congestion and increasing travel times in particular):

- Blue colour represents a 'more is better' strategy (or a conventional fixing-the-problem approach), when more roads are constructed, using the financial resources acquired from road tolls and fuel taxes.
- Red colour aims to strengthen the 'pull' of the public transport loop cluster. Budgets for public transport are increased, under the assumption that this will result in the public transport becoming more available and attractive, which increases public transport use (and ticket revenue) and decreases passenger car use. A particular effective option of addressing the

relative strengths of the public transport and passenger car loop clusters is to channel a share of collected road tolls and fuel taxes to public transport instead of road construction. The higher the share channelled, the stronger the leveraged effect (nevertheless, should public transport attract significantly more users, car use would drop and the income from road tolls and fuel taxes would decrease as well). Nevertheless, a stronger loop R1 would also more strongly contribute to the growth of geographical dispersion of settlements. A more robust solution would therefore also address the link between budgets for public transport and geographical dispersion of settlements, or between dispersion of settlements and passenger car use.

- Green colour represents the 'ecological modernisation' strategy of decreasing environmental impacts of car use (by a technological solution aimed at increasing fuel efficiency of cars or decreasing their noisiness). As stated above, this would make the link between car use and environment pollution weaker and as a result inhibit the balancing function of the loop B2 as well. Such a measure would also weaken the reinforcing loop R4 (i.e. less people would move into new settlements), but the economic and political reinforcing loops of R2 and R3 would have less counterforce.
- The orange colour represents the attempt to directly address the geographical dispersion of settlements by a 'holistic' strategy of increasing the overall quality of life in the existing settlements, thereby lowering the incentives leading their populations to move to new settlements.

The fourth 'lens' is examining connections between several problem issues. It has been suggested that 'distilled' depictions of the system structure underpinning particular issues can be linked in the manner of 'cascaded archetypes' (Wolstenholme, 2004: 350), illustrating how unintended consequences of one issue can become drivers in the next. Such a linking has remained a rarely-addressed 'major research challenge for system dynamics' (ibid.). Figure 4 shows how individual problems can act as mutual limits, balancing each other out and mutually preventing growth in scale. Structures of two heavily simplified problem issues are connected through conflicts over use of land. Pressure on land use and resulting conflicts result from increases in geographical dispersion of

settlements through road construction and take up of land through a shift towards regional food production. The stronger the policy goals, the more pressure would there be on conflicts over land use. Should, for example, the problem of low productivity of regional food production be solved, it would stop contributing to an increase in conflicts over use of land. As a result, there would be less counterforce to road construction and the scale of the problem of road construction and geographical dispersion of settlements could grow until it meets another 'layer of limits' (Meadows, 2008).

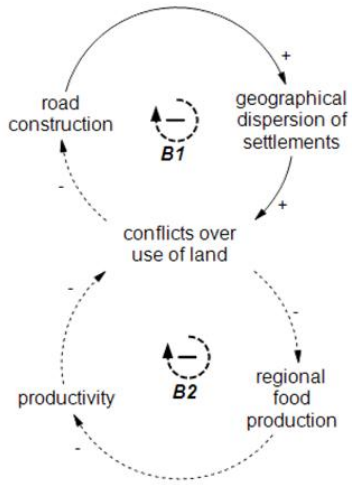

Figure 4. A possible connection between two problem issues

Another option is a cascade where change in one problem issue causes changes in the same direction in other issues. For example, policies aiming to decrease meat consumption could, provided they overcome policy resistance, over time contribute to the popularity of lifestyles of health and sustainability (LOHAS), which encompass more dimensions than just meat consumption. Increasing popularity of LOHAS could therefore plausibly result in an increase of preference for regional and seasonal diet or in an increase of public transport use to a level higher than it would otherwise have been, thereby potentially contributing to an improvement in the problem of car use. Analogously, a decrease in the popularity of LOHAS could affect these linked problems negatively. This example shows that addressing one problem may help solve other problems through systemic spillover effects, rather than the traditional behavioural spillover effect (Thøgersen and Ölander 2003).

5 Conclusions

In this paper we attempted to demonstrate how our usage of the method of participatory systems mapping (PSM) in the context of knowledge brokerage can support various types of insight, thereby supporting a systemic, complex and multi-perspectival understanding of issues related to sustainable consumption. Such an understanding can be reached by simultaneously using several 'lenses' to look at a single CLD. We described 4 different 'lenses' (an overview is provided in Table 1).

Table 1. An overview of different lenses and the insights they produce

'Lens'	Produced insights
Closed-loop thinking	structural causes for observed behaviours, unintended consequences, limitations to policy measures, leverage points, explicit boundaries of thinking (detailed, issue-specific insight)
Factors of influence	implied relationships between factor of influence, necessary conditions for exertion of influence, identification of evidence gaps (detailed, issue-specific insight)
Mental models and strategies	different perspectives, comparison of mental models, comparison of strategies, placing paradigms into a larger picture (actor- and discourse-oriented insight)
Connections between issues	interlocking of problem issues, side effects of policy solutions, system boundaries, higher level of system organisation (policy resistance, resilience, path-dependencies) ('inter-issue' insight)

We have highlighted the discussion-supporting function of CLDs, which is particularly relevant for knowledge brokerage processes involving representatives of various communities. Furthermore, we tried to demonstrate that diagnostically used CLDs possess significant policy-relevant potential by enabling identification of leverage points which serve to conceptualise policy interventions and by supporting thinking about effectiveness, policy resistance and potential side effects of policy interventions. Structuring the problem issues using the language of CLDs also allows identification of missing evidence and knowledge needs of the policy makers (research-related potential). In line with Sterman (2000) we suggest that 'improving' the mental models upon which policy solutions are based

can to a large extent prevent unforeseen and delayed side effects which are the main threat to sustainability (see Figure 5).

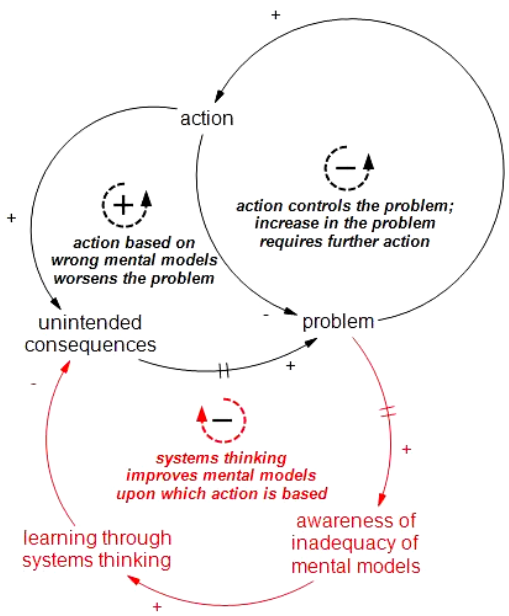

Figure 5. Systems thinking as a way to improve mental models

Our project is to be seen in the context of a stream of studies, initiatives and exercises which might collectively contribute to change of policy to more systemic understanding of sustainable consumption.

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