

Chapter 1 Towards a Systemic Understanding of Sustainable Consumption and Economic Growth

Lessons from Different Consumption Areas

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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. It would seem that government action on sustainable consumption can be characterised by focus 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 which has until now not been influential in policy making) have provided increasing amounts of evidence which suggests that this dominant policy approach might be the reason for the relatively modest success of sustainable consumption initiatives.

To contribute 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. The unique approach of RESPONDER lies in the attempt to bridge not only the science–policy gap but also the ‘pro-growth’–‘beyond growth’ discourse gap (i.e. we are linking four communities: ‘pro-growth’ scientists, ‘pro-growth’ policy makers, ‘beyond-growth’ scientists and ‘beyond-growth’ policy makers). To achieve this, the project utilises systems thinking to exchange knowledge about problems in which concerns of sustainable consumption and economic growth come together. We suggest that the representations of system structure, visualised in

the form of causal loop diagrams, help to better understand the problems of sustainable consumption in several ways. This paper aims to present the method of participatory systems mapping, adapted for the purposes of the project, and to demonstrate to the reader several of these ways, or ‘types of insight’ as we term them, resulting from the use of the visual tool of causal loop diagrams for understanding the links between system structure and system behaviour in problems related to sustainable consumption.

The next section introduces the discursive context of the RESPONDER project and presents our definition of sustainable consumption. The third section describes how systems thinking can be useful in a knowledge brokerage context and describes our objectives and approach. The method of participatory systems mapping (PSM), developed for the purposes of the project, is explained and placed in the organisation of project’s tasks and events. The fourth section provides a theoretical framework of our CLD usage and on five different ways of engaging with CLDs in detail 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 Röpke, 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 systemic understanding, but rather expect that the mapping exercises – even though constrained by the language of CLDs – expose a plurality of systemic aspects to facilitate policy-relevant learning.

3 Operationalising systems thinking in the context of knowledge brokerage: the RESPONDER method

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 prime of systems thinking is about 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’).

Approaches involving clients in systems thinking, applied since the 1970s, have over recent years evolved into, e.g., group model building (Vennix, 1996) and mediated modelling (van den Belt, 2004) which enable a participatory dimension in systems thinking and system dynamics modelling. Since the end of 1960s, and particularly since *The Limits to Growth* (Meadows et al., 1972), systems thinking has had a rich history in areas of sustainable development, natural resource management and ecological economics, with increasing usage in participatory settings in the context of public policy making in recent years (e.g. Hare et al., 2003; FLUF, 2010; van den Belt et al., 2010). While providing structured platforms for active engagement of inter-organizational 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 the area of sustainable consumption, the importance of systems thinking has been increasingly recognised over the last years (see, e.g., Klingert, 1998; Geels et al., 2008; Timmer et al., 2009a, 2009b; Mont and Power, 2010; Soderquist, 2010; Prinnet, 2011). Nevertheless, as of now, a thorough application of systems thinking resulting in useful insights is quite rare (see, e.g., Nemecskeri et al., 2008; Jackson, 2009; Green et al., 2010).

The RESPONDER projects applies the method participatory systems mapping, i.e. participatory development of and discussion over causal loop diagrams (CLD), in the context of knowledge brokerage. The concept of knowledge brokerage builds on the assumption that policy making is a rational process and that its outcomes can be improved by bringing in missing knowledge. The primary reason for missing knowledge is lack of structural coupling and compatibility between knowledge production (the social systems of science) and knowledge use (the social system of policy). These social systems differ across a whole range of features including e.g. incentive structures, working cultures, time horizons or language/discourses used (see e.g. Caplan, 1979; Mitton et al., 2007; EC, 2008: 13–19). In terms of knowledge they possess in particular different perspectives on salience, credibility and legitimacy of knowledge (Cash et al., 2003). It is therefore suggested that strengthening of the structural coupling of these social systems requires knowledge translation mechanisms and intermediary agents (knowledge brokers). Various scholars have suggested that KB can

also create platforms and spaces where multiple types or categories of knowledge or multiple stakeholders can come together in a non-normative environment (see, e.g., the social change framework by Oldham & McLean, 1997; Sheate and Partidário, 2010). Findings also suggest that the uptake of policy-oriented research is significantly increased when its users are involved in all its stages (Jones, 2009: 19), i.e. when greater dialogue between knowledge producers and knowledge users occurs. Until recently empirical evidence was available mostly from the public health sector (e.g. CHSRF, 2004, Estabrooks et al., 2008, Keune et al., 2008, Pyra, 2003, Ward et al., 2009), but through the Seventh Framework Programme the European Commission currently funds a number of projects, including RESPONDER, with the purpose of supporting knowledge brokerage on various issues related to sustainable development.

3.1 The RESPONDER setup

The objective of RESPONDER is to promote sustainable consumption and help improve the management of its social, economic and political contradictions with economic growth through development and facilitation of a knowledge brokerage process. To achieve this, RESPONDER attempts to link four communities – ‘pro-growth’ scientists, ‘pro-growth’ policy makers, ‘beyond-growth’ scientists and ‘beyond-growth’ policy makers – through the neutral and transdisciplinary language of participatorily constructed causal loop diagrams, ‘system maps’.

Causal loop diagrams (CLDs) are probably the most-utilised systems-thinking visualisation tool since the 1960s (see Forrester, 1968). They have been shaped in particular by systems dynamics and cybernetics. 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, a CLD provides an endogenous explanation for observed behaviour. Jackson (2011) also suggests that CLDs are useful for exploring behavioural hypotheses and presenting an established (i.e. non-controversial) evidence-based and systematised knowledge. In RESPONDER we reflect the established use of CLDs while at the same time test their use for knowledge brokerage. In more detail, we use CLDs 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 effect and insights regarding system’s behaviour and identify potential leverage points.

The RESPONDER project contains a number of events in which the participants engage with CLDs. 10 events are devoted to five different consumption areas (sustainable food consumption, sustainable mobility, sustainable housing, sustainable consumer electronics and sustainable finance/household savings and debt) and each consumption area is addressed by two workshops (rounds 1 and 2) set about 9 months apart (see Figure 1). This paper was written when almost all of the workshops of round 1 have taken place (January–May 2012), which enabled us to reflect on our usage of the ‘participatory systems mapping’ method. Figure 1 also shows the steps of development of the CLDs as the sequence was applied for all five consumption areas in round 1. The sequence alternates participatory input and ‘off-line’ expert work.

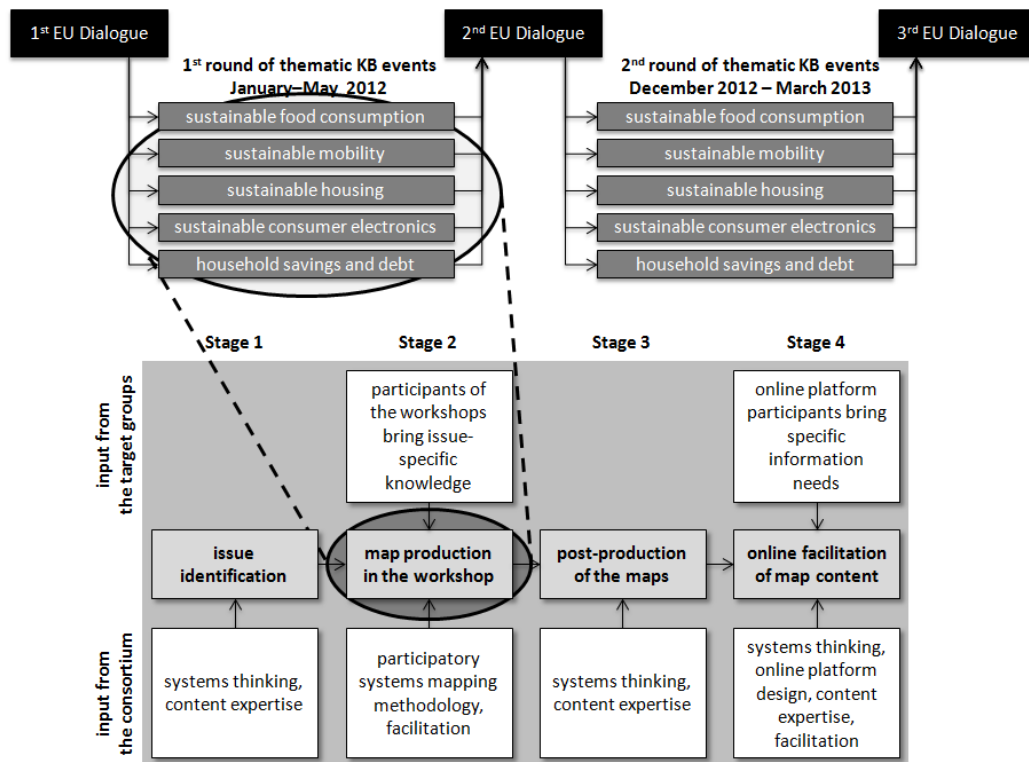


Figure 1. Structure of the RESPONDER events and of the CLD engagement process.

1. In the first stage, on the basis of desktop research and their ‘content expertise’ in macroeconomics, ecological economics and consumer research the consortium experts identified 3 ‘issues’ per consumption area to be mapped during the workshops. These issues reflected particular empirical problematic questions which linked sustainable consumption with macroeconomic (growth-related) concerns. For the second round of events the problem issues will on one hand build on the progress made and knowledge needs identified in the first round, and on the other hand, to increase policy relevance in relation to the Europe 2020 strategy and ‘green growth’ initiatives, linked to either ‘green jobs’, resource efficiency or sustainability of public finance. More details on preparation are provided below.
2. The second stage consists of two ca. 90 minute-long PSM sessions held over a 2-day workshop. The workshops aim for 30-35 participants representing all four target communities, however, during the first-round events the representation has been skewed towards beyond-growth researchers. The participants choose one of the three presented issues so each issue is addressed by drawing a CLD in a group of 10 to 12 participants. CLDs serve as boundary objects (Cash et al., 2003) enabling co-creation of knowledge and exploration of the given issue, and at the same time exchange of knowledge and reflection on various positions and perspectives. A more detailed description of the PSM method is presented below.
3. In the PSM workshop sessions ‘raw’ CLDs are produced, tending to have inconsistencies, errors and under-developed system structures. Utilising both systems thinking and content expertise the experts in the consortium therefore ‘clean up’, process and digitalise the CLDs, reflecting to the highest degree possible the interests and concerns of the participants developing the map. In addition, processing of the CLDs and of the documentation of the workshop sessions provides a basis for identification and framing of the possible foci of the PSM exercises for future events in round 2.

4. Processed CLDs are placed in the RESPONDER online knowledge brokerage platform where original software and web design enable interactive engagement with CLDs, including functions such as: zooming; layered view; explanatory commentaries and references for selected variables, causal relationships and feedback loops; request of additional commentaries; discussion forums. Here CLDs serve to foster interaction and exchange but also individual insight and learning.

3.2 Organisation of participatory systems mapping sessions (stage 2)

Building on participatory modelling approaches and applications (see Richardson and Andersen, 1995, Vennix et al., 1992; van den Belt, 2004; Videira et al., 2009), over several months after the start of the project we developed a method we call ‘participatory systems mapping’ (PSM). Since then we have tested the method on about 30 occasions in group sizes of 8 to 18 participants excluding the facilitator. Application of PSM can best be described as the preparation and execution of a facilitated group process of development of causal loop diagrams to provide insight into a particular problematic issue and enable knowledge exchange.

The method requires a facilitator possessing simultaneously three kinds of expertise: i) systems dynamics/cybernetics expertise; ii) facilitation and moderation skills; iii) expertise related to the issue being mapped. In terms of material the method requires a large sheet of paper of about 1.5 x 2.5 m, larger sticky index cards in several colours and flipchart markers (for the variables which might need to be moved around), pencils and erasers (for recording and changing causal relationships, at the end they can be redrawn with flipchart markers), sticker dots (for voting on knowledge gaps or leverage points) and a flipchart (for documenting the process and recording comments which cannot be captured in the CLD). The viable length of a PSM session is between 90 and 120 minutes – with less time the chance of producing a useful result as well as ‘spotlight time’ per participant decreases and the risk of dissatisfaction grows. We have not experimented with longer sessions but we assume that due to the concentration demand they could lead to fatigue.

As indicated above, preparation also requires identification and formulation of the problem issues to be explored. Drawing on the systems thinking competence in the consortium, we make sure that the problem issues are viable for mapping, and desirably depict unexpected or counter-intuitive developments and lead to useful insights. This involves formulating the issues at an appropriate level of abstraction and complexity, and in a way which ideally supports not only linear causal thinking, but also systemic loop thinking. An issue is expressed through several means. First, two starting variables are formulated, the primary cause variable and the primary effect variable. They provide an implicit system boundary as well as a general causal direction and they guide attention; before the session they are written on two index cards of a colour different from the one to be used for the rest of the variables and placed on the large sheet of paper (the cause near the left side, the effect near the right side). In the future we are planning to experiment with starting with a simple 2 to 3-variable feedback loop. Second, a question, which is a concise expression of the issue and which will guide the mapping, is formulated. The guiding question typically have the form of ‘How can a hypothetical change in one or more variables related to sustainable consumption lead to an (unexpected) change in one or more variables related to economic growth?’. Management of the system boundary during the mapping process is made easy by asking whether a newly introduced element in the map helps to answer the guiding question. Third, a paragraph-long description of the problem is written and provided to all participants prior to the session. The description need to be rich and open enough so as to avoid the feeling that the participants are being ‘tested’, with their task being a more or less mechanical translation of written text into a CLD syntax.

The mapping itself is exploratory and, at least in the first round of events, diagnostic (i.e. striving for a description of the problem in its current institutional contexts such as current regulatory frameworks, actors, values and preferences, market structures etc.). The facilitator strives to create an open and creative atmosphere, focusing not only on the result (the quality of the produced CLD), but also on group interaction and knowledge exchange. A tight facilitation style seems to be the most productive, in particular towards the beginning of the exercise – meaning, the input by the participants is channelled into the map through the facilitator and the facilitator focuses the attention of all participants on the issue currently discussed.

Several steps are followed during the session. There are no strict boundaries between the steps, both in terms of timing or sequence; the facilitator should adapt to the flows and needs of the group in (repeatedly) switching between the steps.

1. Nevertheless, the first step should always be making sure that participants are familiar with the problem issue and CLD syntax.
2. As the next step, most productive seems to be to start mapping the effects of the primary cause. Typically, in the process the ‘left side’ of the map is fleshed out as intermediary variables between the primary cause and primary effect as well as secondary causes are introduced. Also making the primary cause endogenous by identifying its causes or closed loops which contain the primary cause can be helpful to explain the issue.
3. Over time (possibly repeatedly) switching to mapping the causes of the primary effect is desirable. Enrichment of the effect structure is a typical occurrence.
4. In a number of cases, connecting causal pathways from effects back to causes and forming of feedback loops will be beneficial as it can provide for more systemic explanations of the issue.
5. Acquiring feedback from an outside audience (participants of other groups) can be beneficial during the process. Besides receiving feedback, it also forces the group to formulate statements expressed by the map when presenting the map.
6. Analysis of the map using a range of possible ‘lenses’ to produce insight: assumptions behind and evidence for individual causal linkages, relative strength of causal pathways and loops, relationships between factors of influence (causes of a single variable), identification of leverage points, stock-and-flow thinking etc. We highlight several of these approaches and identify their potential benefits below.
7. The last step is voting on knowledge gaps, with the participants choosing variables, causal linkages or loops where they see demand for more evidence or desire more exploration by future mapping.

4 Achieving different types of insight with CLDs: a discussion

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. 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); understandably, a systemic approach tends to place more focus on structure rather than agency. Even though structure can be understood as ‘given’ by material and institutional conditions, particularly in 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). Regarding stability of system structure, 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.

The most important elements of CLDs are variables, which are relevant for explaining the behaviour of the system, and their interdependencies represented by arrows. Relationships are causal and between two variables. They are either positive (drawn as arrows tagged with a plus sign) or negative (dashed arrows tagged with a minus sign).¹ To depict longer time delays between changes in the cause variable and the effect variable (which typically have significant implications on the dynamic behaviour of the system), the arrow is marked with a double slash sign. Central to CLDs are feedback loops (circular causalities) which are either reinforcing (i.e. positive, leading to exponential growth or exponential decay) or balancing (negative, leading towards an equilibrium or goal value). Feedback loops are depicted as independent and smaller circular arrows placed in the free space within a chain of variables and labelled with a plus or minus sign, often named to foster the understanding of the system. Small clusters of reinforcing and balancing feedback loops in certain arrangements are often referred to as the 'engines of the system'. Colours and lines can be added to delineate boundaries between various organisational, geographical, disciplinary, paradigmatic or other areas of a CLD.

Even though most of this section addresses the content aspect of CLDs, we were also able to make some observations regarding the PSM process. It would seem that larger group sizes on one hand enable a higher plurality of perspectives and potentially provide more opportunity for knowledge exchange and learning. On the other hand they also limit the available time per participant and make consensus (which is in one form or another necessary for the production of a CLD), harder to achieve. An ideal balance seems to lie at about 10-12 group participants. The group can also be bigger if it is more homogeneous in respect to the communities and discourses its participants represent. Our experience also seems to indicate that higher homogeneity of the group correlates with a higher pace of the map's development as a lower number of controversial issues are tackled in the process so such a map may be richer in detail but poorer in terms of the diversity of underlying paradigms or disciplines contained.

In the following we will demonstrate some of the approaches towards thinking about CLDs ('analytical lenses') and highlight what types of insight and learning effects they support.

¹ A positive causal relationship between two variables (cause X and effect Y) means that an increase in X will lead to an increase in Y above what it would otherwise have been (assuming all other variables remain constant) and, conversely, a decrease in X will lead to a decrease in Y below what it would otherwise have been. A negative causal relationship is inverse, i.e. an increase in X will lead to a decrease in Y below what it would otherwise have been and a decrease in X will lead to an increase in Y above what it would otherwise have been (for the discussion on the 'proper reading' of causal relationships see, e.g., Richardson, 1997; Sterman, 2000).

4.1 Closed-loop thinking: an example from mobility

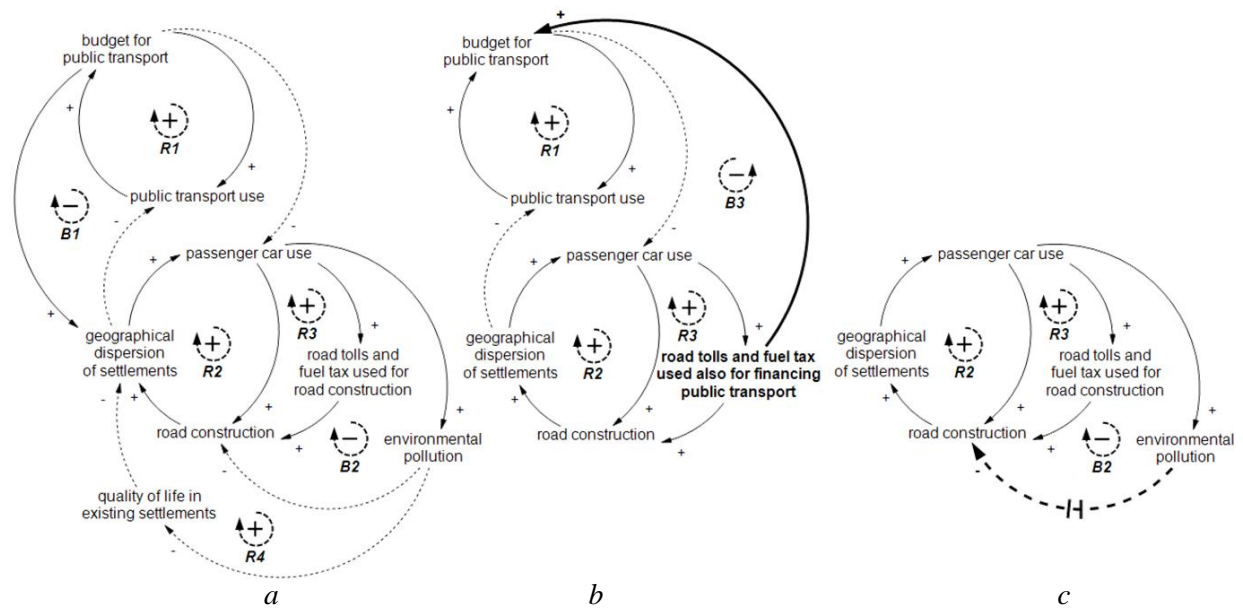


Figure 2. Public transport use vs. passenger car use map with two variants

By enabling to think about interrelationships between feedback loops, CLDs help to understand and infer behaviour of systems over time. Figure 2 shows a simplified excerpt from a system map from the mobility consumption area (map *a*) and its two variants (*b* and *c*). The issue mapped was “How does road construction influence transport volume and modal split?” and the maps above have already been processed (i.e. they are the result of stage 3). The excerpt highlights dynamic tensions between public transport use and passenger car use, i.e. modal split. The reinforcing loop R1 indicates that an increase in public transport use will (through an increase in net ticket revenue) be reflected in budgets for public transport being higher than they would otherwise have been. Proper spending of these budgets should result in the public transport becoming more available and attractive which further increases public transport use and decreases passenger car use. This loop, when unchecked, would cause that public transport use and budgets for public transport grow exponentially. Nevertheless, geographical dispersion of settlements (the balancing loop B1) is pulling against this reinforcing tendency. 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). For the sake of brevity a number of other limiting factors is not included in the map (e.g. factors inhibiting switching from car use to public transport relating both to individual and social aspects, population size or urbanisation structure) and many of the causal relationships are simplified (e.g. between budget and public transport use).

Another cluster of loops shows the feedback processes underpinning private passenger car use. The reinforcing loop R2 represents the political pressure to construct new roads or widen existing roads as a traditional (and short-sighted) way of fixing the problem. With increasing car use, the importance of automotive industry for domestic economy and the political weight of car users would be higher than otherwise, which would result in more road construction. This would, in turn, result in an increase of geographical dispersion of settlements and in a further increase in car use, thereby over time exponentially increasing the scale of the problem. The loop R3 adds a second powerful reinforcing effect, the economic dimension of financing road construction through road tolls and fuel taxes. The loop R4 shows how the negative impacts of increasing car use further contribute to the 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 a further growth of the geographical dispersion of settlements which, unfortunately, additionally contributes to an increase in car use. This set of three reinforcing loops, potentially further strengthened by the influence of availability of public transport on dispersion of settlements, is counterbalanced by only two forces: the attractiveness and availability of public transport as a factor causing switching from car to public transport use, and by the balancing loop B2. This loop represents public pressure and change in regulation and political priorities in response to environmental pollution caused by car use, which would result in road construction being less intensive than it would otherwise have been.

Of course, without simulation the behaviour of the system (i.e. the change in modal split over time) can be only roughly inferred. The map, however, invites discussion on the relative strength of feedback loops, time delays and possible solutions. It could be theorised that the loops R2, R3 and R4 are much more powerful than the balancing loop B2, and that the resulting moment of the ‘engine’ related to passenger car use is 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 use at an accelerating rate.

The second variant (map *b* in Figure 2) shows a potentially powerful leverage point. (The changes to map *a* are depicted in bold. The rest of *a* is untouched, even though it is not reproduced in its entirety in map *b*.) If a share of collected road tolls and fuel taxes would be channelled to public transport instead of road construction, relative strengths of the passenger car use ‘engine’ and the public transport ‘engine’ would change. In more detail, the economic reinforcing loop R3 would become ‘weaker’ and the loop R1 related to attractiveness and availability of public transport ‘stronger’. This effect would be the more pronounced, the higher the share channelled to public transport would be. (Should 100% be channelled away from the car use cluster, the link between road tolls and road construction, and thereby the loop R3, would disappear.) Nevertheless, this solution has its limits as well. The new loop B3 suggests that should public transport attract significantly more users, car use would also be significantly lower than otherwise. It is possible that other factors (peer pressure and position of a private car as a status symbol, growth in household incomes, availability of consumer credit or leasing etc.) would still cause growth of passenger car use in absolute numbers; but should this trend reverse, unless the fees per unit of passenger car use grow the income from road tolls and fuel taxes would decrease as well. In these conditions, the more successful public transport use vis-à-vis car use would become, the less effective this policy measure would also become. In addition, a stronger loop R1 would also more strongly contribute to the growth of geographical dispersion of settlements. A more robust solution could therefore be weakening the link between budgets for public transport and geographical dispersion of settlements, or between dispersion of settlements and passenger car use.

The third variant (map *c*) is a modification of map *a* only in the respect of placing a time delay on the arrow between environmental pollution and road construction. If public mobilisation and political change represented by this arrow become noticeably slower than the causal relationships in loops R2, R3 and R4, the current strength with which the balancing loop B2 counteracts road construction is at any time equivalent to the state of environmental pollution only some time ago. This would effectively weaken B2’s balancing function of keeping car use at acceptable levels. Also, perhaps surprisingly, a policy solution towards decreasing the environmental impacts of car use (by, e.g., increasing fuel efficiency of cars or noise caused) 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 goal of this relatively detailed analysis was to demonstrate the issue-specific insight that can be acquired through CLDs. The ‘lens’ of closed-loop thinking facilitates understanding of structural causes for observed behaviours in a specific problem, helps to uncover unintended consequences of actions and limitations to policy measures, and makes boundaries of thinking explicit.

4.2 Factors of influence and their interactions: an example from housing

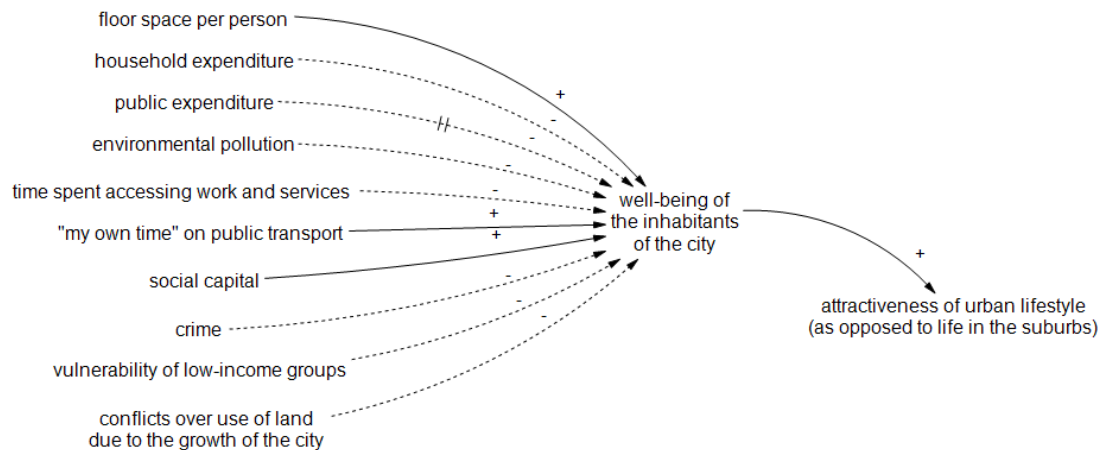


Figure 3. Factors influencing well-being of the inhabitants of the city

In this example we will show an approach that, complementary to closed-loop thinking, also fosters a detailed understanding of a particular problem. Figure 3 represents an excerpt from a map developed at a session focusing on sustainable housing, the issue mapped was “What effect does mono-functional urban planning have on the well-being of citizens?”. It depicts 10 factors influencing well-being of the inhabitants of the city, identified during the mapping process by the participants (i.e. the map is a result of stage 2); all factors were endogenous to the system. We suggest that it is possible to acquire a more detailed insight by focusing on the factors of influence of a particularly important variable, in this case well-being of the inhabitants of the city. An increase in floor space per person, of ‘my own time’ on public transport (meaning the ‘private’ time spent reading, relaxing or conversing while comfortably travelling), or of social capital would cause an increase in the average inhabitant’s well-being to a level higher than it would otherwise have been. An increase in costs (reflected in higher household or public expenditure), environmental pollution, time spent accessing work and services, crime, vulnerability of low-income groups, or conflicts over use of land would result in well-being being lower than it would otherwise have been (for public expenditure, this effect would occur with a time delay and to a large extent indirectly through deterioration of infrastructure, increase of taxes and fees, lower quality of public services etc.). This also demonstrates that a systemic approach makes it easy to cross the boundaries of policy areas or scientific disciplines: in the map above variables related to housing, transport, crime or social capital inter-relate.

Furthermore, a CLD facilitates a discussion about interrelationships between influencing factors: Are factors complementary (this could be formalised as a multiplicative relationship) or substitutive (an additive relationship)? 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 some additional conditions? Does a factor cause a qualitative change and perhaps require splitting of the effect variable into several? Are the functions between individual factors and

well-being linear? Furthermore, what scientific evidence exists for particular causal relationships? As an example related to Figure 3, what is the relationship between the influence of each of household expenditure, environmental pollution, time spent accessing work and services, social capital and crime on well-being? Or perhaps, in more detail, how is the enjoyment of ‘my own time’ dependent on the quality of public transport and time spent travelling? The map in Figure 3 facilitates bringing in existing debates around well-being into the process of map construction or later usage, fostering learning of participants.

It is easy to switch between this and the previous ‘lenses’ during map construction and analysis. Closed-loop thinking could, in this case, seek for linking changes in well-being (which has been the primary effect in this issue) back into the system through responses of various actors (including policy response). Changes in well-being of city’s inhabitants could, as an example, affect attractiveness of urban lifestyle as compared to life in the suburbs and thereby open up feedbacks to variables such as value of both urban and suburban properties, public expenditure, social stratification or mobility, directly or indirectly influencing well-being.

Using this lens turns attention to whether depicted factors are sufficient in explaining the observed phenomenon, to their implied relationships and necessary conditions, as well as to identification of knowledge gaps and need for evidence. This provides a complementary tool for obtaining more detailed insight about a particular problem issue.

4.3 Generalising lessons learned: an example from food

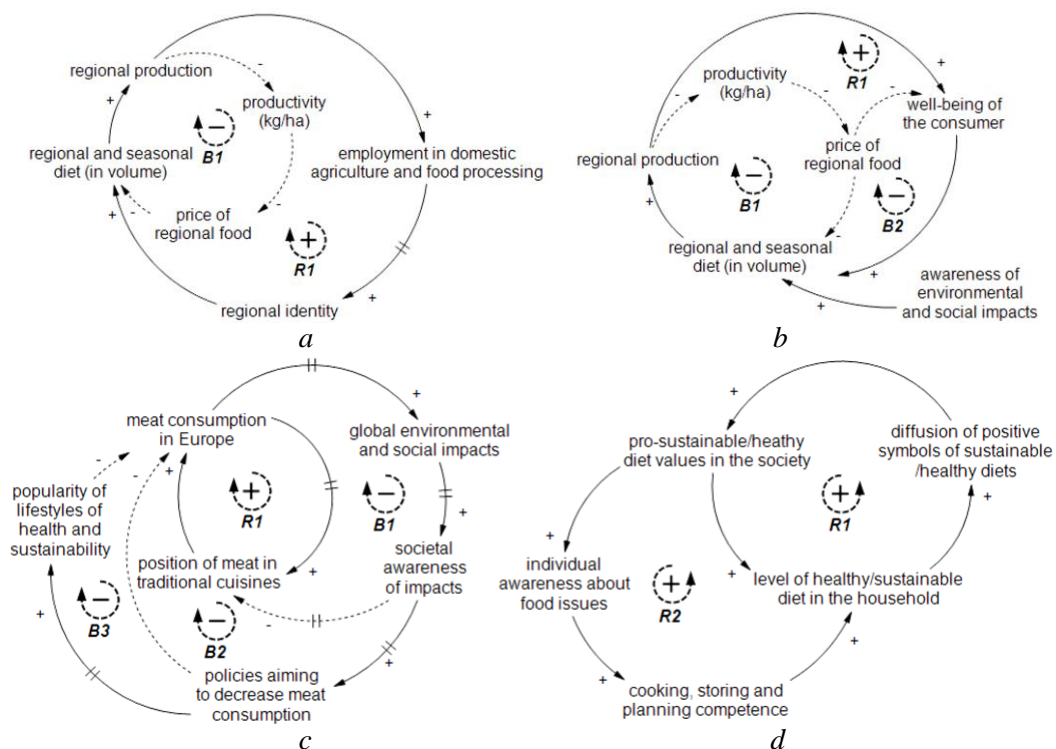


Figure 4. The role of the social in sustainable food consumption, four examples

Comparing some of the key feedback loops from maps representing several problem issues can also generate useful insights. We found striking that variables related to ‘the social’ play a much higher role for an increase in sustainability-related practices in the area of sustainable food consumption than in other consumption areas. Figure 4 shows partial ‘distilled’ maps from four mapping sessions (i.e. results of Stage 3). Maps *a* and *b* were developed around the issue ‘How does increasing consumption of regional produce affect the employment in

domestic agriculture?', map *c* around the issue 'What factors influence the global environmental effects of a shift to a Mediterranean diet (less meat) in Europe?', and map *d* around the issue 'Could healthier and more sustainable diets lead to increased food waste in European households?'.

In map *a*, lower productivity and higher price of regional food resulting from an increase of regional production serve as limiting factors to increases of regional and seasonal diet. The balancing loop B1 would cause the volume of regional and seasonal diet to even out towards a certain level. (Again, the relationships recorded in the map are simplified – e.g., they do not reflect that initially an increase in regional production may cause an increase in productivity; also, this group has not identified awareness of environmental benefits of regional production as important.) Against this loop pulls the reinforcing loop R1, representing a delayed positive effect of an increase of employment in domestic agriculture and food processing on regional identity, which should in turn cause the volume of regional and seasonal diet to be higher than it would be otherwise. It would seem that the balancing loop B1 is relatively stronger than the loop R1 relying on regional identity, which might be insufficient (note also the time delay) to overcome the material and economic limiting conditions of production. Ensuring lower productivity losses or higher employment effects of regional and seasonal production or removing the time delay between employment and regional identity would change the relative strengths of the loops. Nevertheless, the social dimension, expressed as regional identity, has a key function in this map.

Map *b* is an attempt to explain the same issue by a different group, focusing instead of regional identity on the variable of well-being of the consumer (i.e. the frame is 'individualistic'). Well-being of the consumer is negatively influenced by higher price of regional food (loop B1) and positively influenced by various benefits of regional production (loop R1) such as sense of fairness, producer–consumer proximity or diversity of local/regional production. One of the key assumptions in this map is that an increase in well-being from these benefits would (perhaps in combination with individual's awareness of positive environmental and social impacts not related to objective well-being) result in higher demand for regional and sustainable food and thereby in an increase of the volume of regional and seasonal diet. This assumption enables to close the loops R1 and B2. Achieving higher well-being gains from regional production or ensuring a lower price would change relative influences of B1+B2 and R1 and would translate into higher volume than it would be otherwise. Awareness of environmental and social benefits of regional production does not directly contribute to well-being, but it contributes to a higher volume of regional and seasonal food. Compared to the factor of relative strengths of B1+B2 and R1 it does not seem to be critical. As can be seen from the comparison of *a* and *b*, different framings of the same issue could result in identification of different intervention options. Although addressing the lower productivity problem or subsidising the price of regional food would work for both (as they address the same loop), in *a* reasonable policies could include increasing the number of jobs per unit of production as well as achieving a stronger association between employment in domestic agriculture and regional identity, whereas in *b* they could include improvement of direct benefits for consumers and providing consumers with information about positive environmental and social impacts.

Maps *c* and *d* express the social dimension of food consumption in more detail. Map *c* shows that relying on social processes alone can be risky because of the numerous time delays. Participants have placed a time delay on the translation of negative global environmental and social impacts into collective awareness, on the effect of changes in awareness on change in cultural traditions or (through collective pressure) on a change in policies, and on the effect of policy on change in lifestyles (which, in addition, might meet with policy resistance). Since the balancing effect of all three loops would counteract an initial increase in meat consumption too late (after three time delays, which is a time during

which meat consumption can further grow), significant environmental or social damage could occur in between. Removing the time delay between meat consumption and occurrence of negative impacts might not be possible, but addressing the time delay between the impacts' occurrence and collective awareness is an important leverage point (to a smaller extent this is valid for all other time delays in the map). Furthermore, it invites discussion on the relationship between values and discourses, and practice (loop R1), since mobilising the reinforcing effect for a decrease of meat consumption could be crucial. Despite the difficulty of inferring behaviour due to time delays, this map supports a discussion about the possibilities of policy instruments to affect the speed (and direction) of change of societal values, discourses or practices.

By placing the individual perspective into a social context, map *d* more closely examines these issues. The social dimension is primary, since it is the source of reinforcing dynamics (loop R1). The loop suggests that societal values are translated even without a premeditated decision of the individual into individual practice, which in turn has communicative effects. The loop R2 shows how actions and decisions of the individuals reinforce the social dynamics: societal values affect individual awareness, awareness translates into development of competence, and competence translates into practice (a sequence which roughly corresponds to the traditional ABC). The ABC approach is placed into the context of a more powerful social dynamics.

Maps *a* and *b* demonstrate how different framings of the same issue (i.e. the 'individualistic' vs. 'social' perspectives) could lead to different policy outcomes. Map *c* underscores the importance of time delays in relation to the social dimension, which make the system more problematic but are also potentially powerful leverage points. Map *d* shows in more detail one possible conceptualisation between the individual and social dimensions. All of them provide insights which can be generalised or transferred to other issues, perhaps not only in the area of food consumption. This is supported by the concise or 'distilled' representation of the maps.

4.4 Mental models and paradigms: different ways to decrease TMC

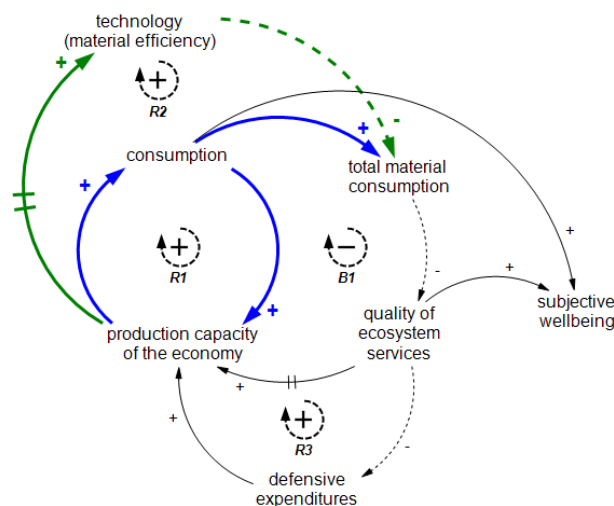


Figure 5. Decreasing total material consumption, two strategies

One of the ways to better understand a system is also through understanding the various mental models, perspectives and discourses which different individuals and social groups have in respect to the system. This strategy has been pursued in particular in 'soft systems thinking' and 'critical systems thinking' approaches. Since RESPONDER attempts to link different communities with different paradigms and discourses, the mapping sessions have

served also as a means to explore these differences during the construction and interpretation of the maps. Nevertheless, we have not uncovered the full potential of this ‘analytical lens’ yet – primarily because, until now, representation of communities other than ‘beyond-growth’ scientists in the events was low.

The map in Figure 5 shows an abstract representation of economy–environment relations with the focus on consumption, prepared during background work on the project. The colours represent two different approaches, preferred by different communities, towards lowering total material consumption (TMC) and preserving the quality of ecosystem services. The green colour represents a strategy to increase material efficiency of consumption while leaving the overall engine of economic growth (loop R1) intact to realise gains from consumption growth on subjective well-being. This is the ‘weak sustainability’ position. The structure of the map would suggest that increasing the quality of ecosystem services weakens one limit to the growth of production capacity of the economy (i.e. the delayed influence of the erosion of the ecological basis of the economy, loop B1) and weakens one contributing factor as well (lower defensive expenditures, i.e. loop R3, will contribute to the growth of production capacity to a smaller extent than they would otherwise). Nevertheless, growth caused by loop R1 would continuously increase the pressure on constant improvement of material efficiency, should TMC be kept in check over a longer term.

The blue colour shows a strategy of addressing TMC through lowering consumption. This can be associated with the ‘strong sustainability’ position. In addition to pushing down TMC, this strategy directly tackles economic growth by (perhaps with a time delay) decreasing production capacity of the economy (loop R1). The behaviour of reinforcing loops tends to either exponential growth or exponential decay (as can be witnessed in the times of economic crisis). Decreasing consumption could generate a spiralling effect of economic de-growth which, however, would be slowed down by the positive effects of healthy ecosystems on the economic base. (A more qualitative change in the structure of the system would also be probable in such a case.)

Even this rudimentary example shows the usefulness of attempting to ‘translate’ various paradigmatic perspectives into the shared language of CLDs as it provides a shared basis for their analysis and comparison, opens minds to different perspectives and provides a more complex picture of the issue. A potential challenge which needs to be explored is that due to different framing individual system pictures might not be easily integrated into a common whole.

4.5 Connections between problem issues: conflicts over use of land and popularity of LOHAS

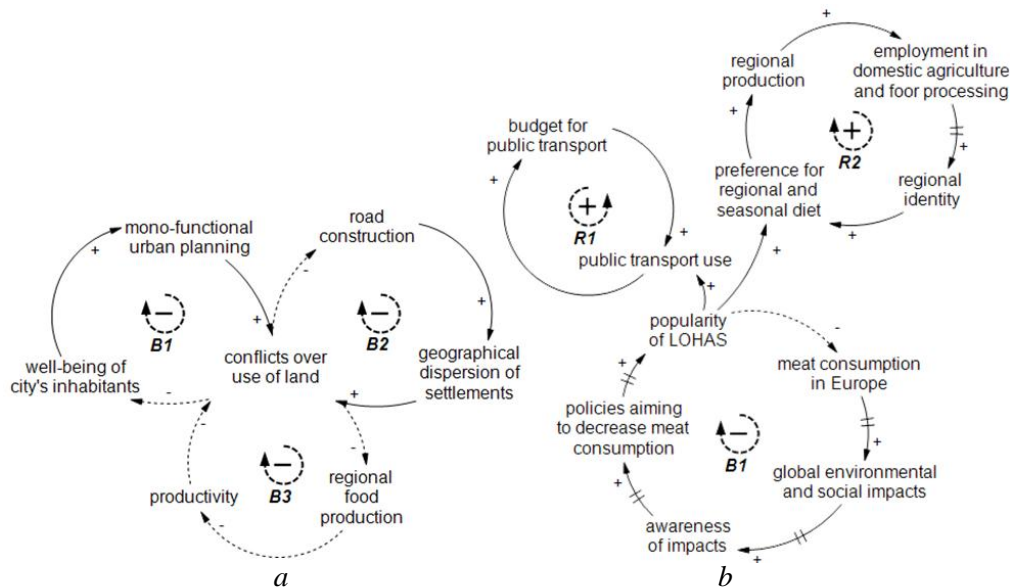


Figure 6. Two possible types of connection between problem issues

Our last 'lens' is looking at connections between 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.). We will briefly examine two possibilities for connections between problem issues.

In Figure 6, map *a* shows how individual problems can act as mutual limits, balancing each other out and mutually preventing growth in scale. Structures of three heavily simplified problem issues (mono-functional urban planning, road construction, and low productivity of regional food production) 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, surface size of the city through mono-functional urban planning and take up of land through a shift towards regional food production. 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). When problems limit each other, solving one problem would remove a limit to the growth of another problem.

Map *b* connects problem issues into a cascade where change in one problem issue causes changes in other issues. Policies aiming to decrease meat consumption would, 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 above what it would otherwise have been, thereby providing more counterforce to the loop R2 against the balancing loop related to falling productivity (loop B1 in map *a*, Figure 4). Similarly, increasing popularity of LOHAS could result 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/road construction/geographical dispersion of settlements. 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 as well.

We suggest that thinking about how problem issues might be connected produces what we call ‘inter-issue’ insights. The architecture of interlocking of the individual sustainable consumption issues is critical for understanding possible side effects of policy solutions – side effects which happen outside of what we would intuitively consider as system boundary. In effect this ‘lens’ expands the system boundary and casts light on a higher level of system organisation, providing a better understanding of policy resistance, the system’s resilience or path-dependencies.

5 Conclusions

In this paper we followed two objectives: i) to explain our usage of the method of participatory systems mapping (PSM) in the context of knowledge brokerage; and ii) to demonstrate the various types of insight facilitated by causal loop diagrams (CLDs) that support a systemic, complex and multi-perspectival understanding of issues related to sustainable consumption. 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 7).

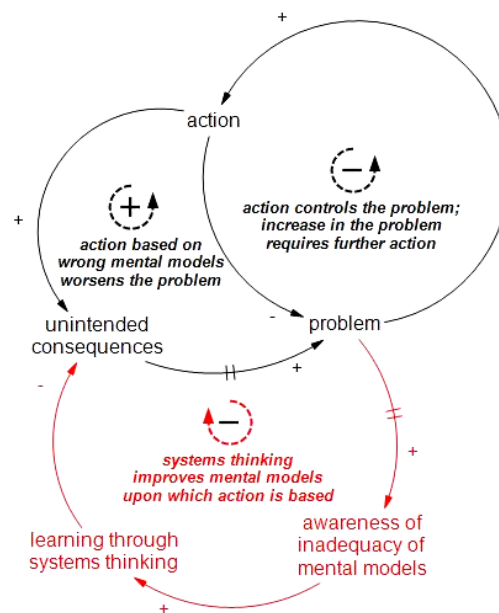


Figure 7. Systems thinking as a way to improve mental models

Types of insight which we identified include a detailed, issue-specific insight (supported by the ‘analytical lenses’ of closed-loop thinking and looking at factors of influence and their interactions), an insight enabling generalisation and transfer of understanding between various problem issues, an insight into different mindsets and perspectives represented in a CLD, and an ‘inter-issue’ insight into the interlocking of individual problem issues and higher level of system organisation. 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. In relation to sustainable consumption and the orientation of the RESPONDER

project we believe that CLDs can stimulate exchange and learning about the sustainability of governmental solutions pursued under the recent green economy initiatives as a remedy to the recent economic crisis (such as the car scrapping premium). 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).

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